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FOR

HOME OWNER, CRAFTSMAN

AND HOBBYIST

IN TWELVE VOLUMES

Volume V

Complete Index in Volume XII

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GASOLINE-DRUM RACK

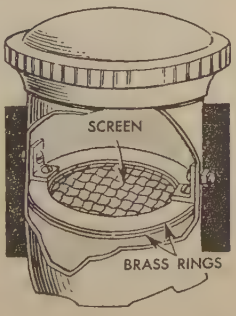
Made From Old Auto-Wheel Rim

This neat-appearing rack for holding a gasoline drum was made by cutting old auto-tire rims into smaller sections and welding them in the manner shown. The

supports are joined together by pieces of flat steel which are welded to the lower sections, or legs, of the rack. The legs are prevented from sinking into the ground by setting the rack on short planks. However, if the barrel is to remain in the same position indefinitely, it is a good idea to pour a small concrete slab for the purpose. A coat of aluminum paint or a regular metal paint will improve the appearance of the rack.

GASOLINE SIPHON-FOILER

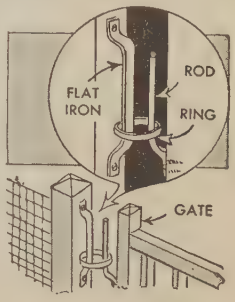
To prevent siphoning of gasoline from his auto tank, one motorist bolted heavy ⅛-in. mesh screen between two brass rings of the proper size to fit inside the filler pipe, and then placed this screen about 2 in. from the top of the pipe. To install it, holes were drilled in opposite sides of the pipe and two small corner braces were fastened to the screen so that it could be bolted in place.



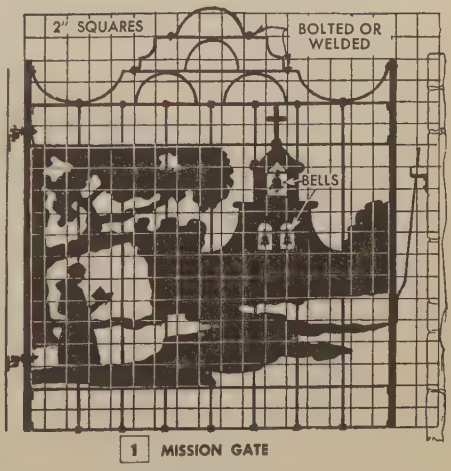
GATE LATCH

Easily Constructed Gate Latch

Only a ring and two door handles or short lengths of rod and flat iron are required to make this simple but effective gate latch. If door handles are used, a ring is slipped over one which is screwed to the fence post. One end of the other handle is cut off and fastened to the gate with the open end up. To close the gate, slip the ring over the open end of the handle. If rod and flat iron are used to make the latch, form the pieces in the manner indicated in the circular detail.



GATES

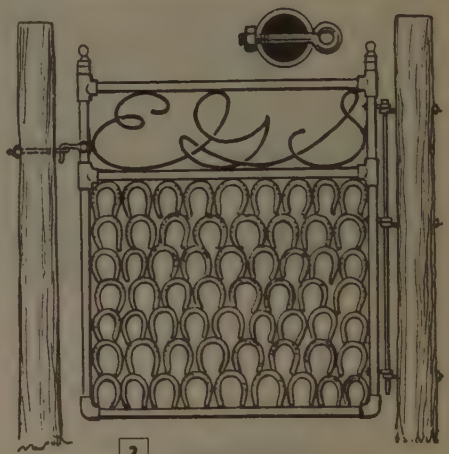


1 MISSION GATE

Here are two unusual and interesting gates for a garden entrance or pathway to the house. The mission gate, Fig. 1, with its tinkling bells, and the ranch-type gate paneled with horseshoes, will impart a Western atmosphere to your grounds. The mission gate is constructed of two ¾-in. iron bars used as end posts, to which are bolted four crosspieces made from 3/16-in. flat iron. The seven vertical members are ⅜-in. iron rods, threaded at both ends and fastened to the top and bottom pieces with two nuts. Form the ornamental ironwork at the top of the gate from the same mate-

rial as the four crosspieces and bolt it to the end posts. The gate is pivoted on eyebolts and is fitted with a spring-type latch. Make a full-sized paper pattern for the silhouette and tape it to a piece of 26 or 28-ga. sheet metal. Then cut out the metal silhouette by using a small cold chisel and anvil. Mount the bells in position rigidly so they will ring only when the gate is moved, and solder the silhouette to the gate. After assembling, paint the gate with red lead and then finish a dull black to contrast with brass or silver bells.

Construct the ranch-type gate, Fig. 2, from 1-in. pipe, using tees and elbows where indicated. Over-all dimensions are determined by the size of horseshoes used which are either welded together or merely wired to poultry fencing stretched over the opening. Add a personal touch to the gate by forming "rope" initials from a single length of soft-iron wire and welding or wiring them to the upper opening of the gate. In keeping with the western theme, suspend the gate between two bark-covered posts. A ⅜-in. iron rod inserted through eyebolts in the edge of the frame and in one of the supporting posts, forms the hinge. Add a nut to the top of the rod to prevent it from sliding through the eyes, and cap the open tees with pipe plugs.



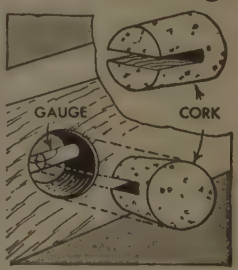
2 RANCH-TYPE GATE

GAUGES

Handy Fillet and Radius Gauge Cut From Celluloid

As a timesaver in checking fillets and radii, this handy gauge, which can be cut from celluloid or clear plastic, will be useful to cabinetmakers and metal workers as well as to home craftsmen. The gauge need be only as large as a pocket comb. All radii are laid out by compass, then routed and filed smooth.

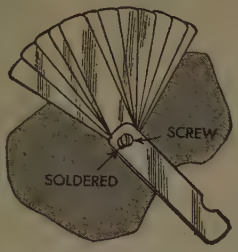
Slotted Cork Will Protect Gauge



Accidental breakage of the glass gauge in a level can be prevented by slipping a cork guard over the glass when it is not being used. The slot in the cork should be a snug fit over the glass and the cork should be a tight fit in the mounting hole. Cut the cork so it does not project from either side of the level.

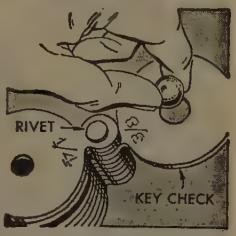
GAUGES

Solder Holds Gauge Screw Tight



Machinists and mechanics who use feeler gauges often find that the screw holding the blades together becomes loose and the gauge falls apart, resulting in lost or damaged blades. To prevent this, place a drop of solder so it covers part of the screw head and side of the gauge. This will keep the screw from turning.

Checking Ball-Bearing Diameters



Here's an easily made gauge to check the diameter of ball bearings. Secure a number of blank key checks having the shape illustrated and drill each piece for a different size of ball bearing. When you have completed a set that will suit your purposes, rivet or bolt the leaves together.

Hanger—Gauge to Apply Siding

It's easy to apply beveled siding with this combination hanger and gauge. A board about 2 ft. long is used to make it, the notches being cut to fit the siding. The top notch should be cut a little deeper so the board will slide under it after the gauge is nailed in place.

Feeler Gauge Made of Scrap Metal

Mechanics who work with sheet metal will find this feeler or thickness gauge a welcome addition to their set of tools. The one illustrated is made of aluminum scrap ranging from .016 to .250 in. in thickness. Cut the leaves uniform in size and use either metal or hardwood for the covers. Clamp the pieces together and smooth the edges with a file. Then drill a hole for the bolt that holds them together. Finally, identify each piece by stamping the thickness on it. When assembled, peen the end of the bolt over the nut so the gauge will not come apart.

Gauge Aids in Cutting Your Hedge at a Uniform Height

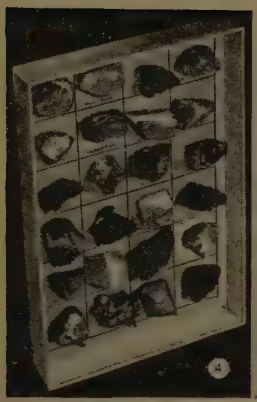
I find that this simple gauge helps in trimming my lawn hedge at the same height. It is made of ¾-in. wood and has an adjustable arm that projects over the hedge. Cheap furniture casters permit it to be moved along as the trimming progresses. Of course, the ground or sidewalk along the hedge must be fairly uniform, otherwise you are likely to trim the hedge to the same contour as the ground when using the gauge as a guide.

START A GEM

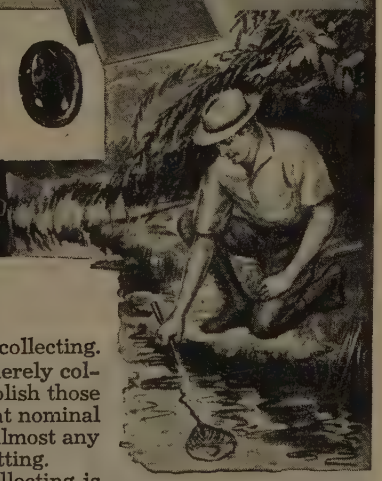
LID
¾" X 12 9/16" X 14¾"
HOLES FOR WIRING
12 9/16"
1½"
OVERLAY
LID STAY
6"
PARTITION
6"
8"
12¼"
⅜"
⅜" X ¾"
RUNNERS FOR TRAYS
¼" X 1 1/16" DRAWER RUNNERS
22"
BACK ¼" PLY.
BOTTOM
¾" X 12 9/16" X 14¾"
½" DRAWER RUNNER
9½"
9⅛"
11¼"
RAIL
¾" X 1⅝"
SHAPE LEGS TWO SIDES
3" ROUT
METAL
1"
8"
RING SOCKET
CANOPY SWITCHES
WIRING
⅛" PLYWOOD PARTITIONS ⅞" HIGH
¾"
SIDE ½" STOCK
TRAY
2⅜"
TOP DRAWER
2⅜"
11½"
¼" X ¾" GROOVE
¼" PLYWOOD
12⅜"
DRAWERS NO: 2, 3, 4
1½"
1½"
¼"
¼"
⅛"
12 9/16"
TRAY
12"
SIDE
¾" X 12" X 22"
33"
7/16"
¾"
SHAPE
9⅛"
OVERLAY

Here's your gem cabinet

Holding 150 to 200 specimens, this cabinet is ideal for the beginner's mineral collection. A black and a white bulb, controlled individually, provide illumination. Black bulb is for viewing fluorescent minerals

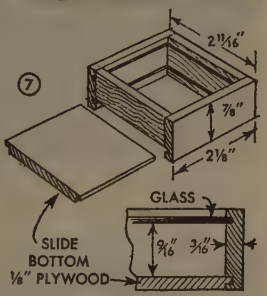


COLLECTION

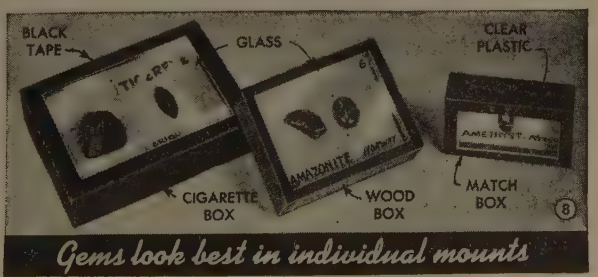


IF YOU are looking for a new hobby, try mineral collecting. You can go at it in one of two ways. You can merely collect minerals or you can collect and then cut and polish those rated as semi-precious gems. Stones are available at nominal cost, but it is more fun prospecting for your own. Almost any beach or river bed will yield stones suitable for cutting.

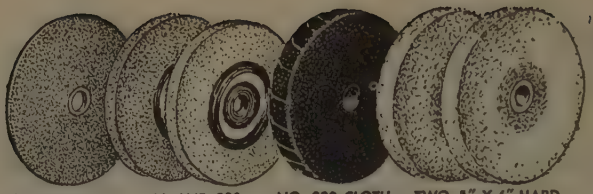
The gem cabinet: Like any other hobby, gem collecting is most enjoyable when you can display your work. A small cabinet for this purpose is pictured in Figs. 1 and 2, and is detailed in Fig. 3. The hinged lid carries a white bulb and a black bulb, the latter for viewing fluorescent minerals. Two sliding trays in the upper part of the cabinet provide room for 16 individual gem mounts. The top drawer has a tray and 36 compartments. The second, third and fourth drawers have 16 compartments each for larger specimens, and the large bottom drawer is plain. However, the arrangement can be altered to suit, but this plan will be found very satisfactory, as it provides accommodations for 150 to 200 specimens.



Individual mounts: Cut and polished stones look best in individual mounts and should be mounted on white cards together with a small piece of the raw material if available. A good type of mount is shown in Figs. 5 and 7. The slide bottom permits ready removal of the stone. Rubber cement is used to mount the stone on a white card, which then is pushed up from the underside of the mount until it is tight against



Gems look best in individual mounts


50-GRIT DIAMOND SAW 6" DIAMETER
100 AND 220-GRIT SILICON-CARBIDE WHEELS
NO. 220 CLOTH-BACKED ABRASIVE ON WOOD WHEEL
TWO 1" X 6" HARD FELT WHEELS

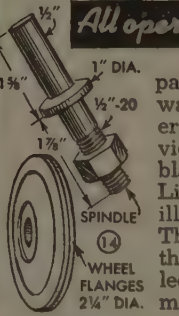
Equipment you'll need (12)

All operations can be done on drill press

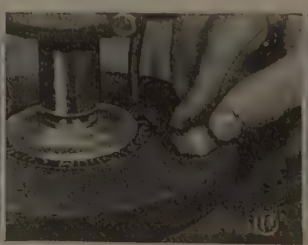
the glass. Corrugated cardboard is used as a filler. Two very simple mounts are shown in Fig. 8. One of these is a cigarette box with the top cut out and covered with black gummed tape after the stone is mounted; the second is an ordinary penny matchbox treated in a similar manner.

Minerals: Start your collection by purchasing two or three ordinary mineral assortments. Some of these are already boxed, Fig. 4, and can be obtained for as little as one dollar for 24 specimens. These usually are not cutting material, but are colorful and a worthwhile part of your collection. You will certainly want a set of eight or 10 fluorescent minerals. These are just ordinary stones when viewed under ordinary light, but under the black bulb they glow in brilliant colors. Likely, you will want a set of minerals illustrating Mohs' scale of hardness, Fig. 9. Then there are many unusual minerals that add considerable interest to any collection: natural stone crosses and beautiful masses of rock quartz crystals; lodestone

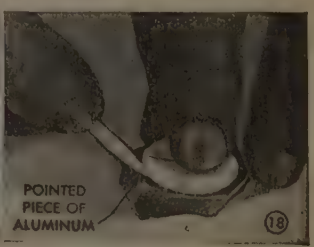
1—Break large stone into small pieces. Further trimming can often be done by pinching off the pieces with a pair of pliers



2—If diamond saw is available, trim stone by sawing. Use plenty of water. Hold stone steady. Speed 2400 r.p.m.



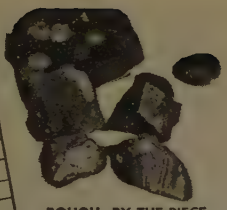
3—Grind base of stone flat on 100-grit wheel. Use plenty of water. Speed 1200-2400. Repeat operation on 220 wheel



4—Mark outline of stone, using pointed piece of aluminum

MOHS' HARDNESS SCALE		
No.	Mineral	Comparative Mat'l
1	Talc	Lead - 1½
2	Gypsum	Fingernail
3	Calcite	Copper coin
4	Fluorite	Iron - 4-5
5	Apatite	Knife blade
6	Feldspar	File - 6-7
7	Quartz	Garnet
8	Topaz	Steel - 5-8½
9	Corundum	Silicon carbide - 9½
10	Diamond	

(9)



ROUGH—BY THE PIECE OR POUND

SLICED—USUALLY ¼" THICK

(10)

READY-CUT—STONES ROUGH-GROUND TO SHAPE

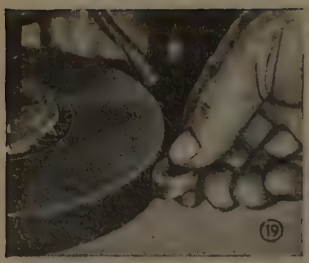
Buy gem material any of three ways

(11) SELECTED CABOCHON CUTTING GEM MATERIALS

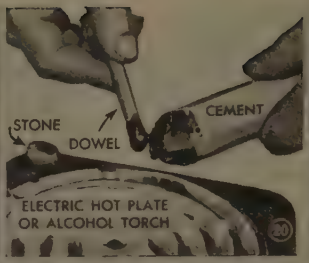
Name of Mineral	Hardness 1	Spec. gravity	Color 2	Transparency and luster 3	Cost 4	Remarks
Agate, banded	7	2.7	Usually red-brown and white in bands	Translucent glassy luster	Low	Best known agate. Usually very attractive coloring
Agate, moss	7	2.7	Red, green or gray	Translucent glassy to waxy	Low	Shows moss growth in interesting patterns
Agate, scenic	7	2.7	All colors	Translucent glassy	Low to med.	Inclusions resemble flowers, trees, etc.
Agate, Sweetwater	7	2.7	Gray, with dark inclusions	Translucent waxy	Low	Sweetwater, Wyo. A moss agate—water worn pebbles
Amazonite	6½	2.5	Green, lightly streaked with white	Opaque glassy	Med.	Variety of feldspar. Nice color
Azurite	3½	3.7	Deep blue	Opaque waxy	Med.	Too soft for rings. Tends to undercut
Chlorastrolite	5½	3.2	Green with white markings	Translucent to opaque-glassy	High to v. high	Water worn pebbles. Often chatoyant 5
Chrysocolla	3	2.2	Green or green-blue	Translucent to opaque-glassy	Med.	Rather soft. Very nice blue color
Dinosaur bone	7	2.6	Usually red, brown or black	Usually opaque waxy	Low	Bone replaced by agate or jasper. Often nicely marked
Jade, American	6½	3.1	White to green	Translucent glassy	Med. to high	Oregon (grossularite). California (vesuvianite). Good cutting
Jasper, breccia	7	2.6	Mixture of various colors	Opaque waxy	Low	Attractive coloring. Also "puddingstone"
Jasper, poppy	7	2.6	Usually red with yellow markings	Opaque waxy	Low	Attractive coloring. Also known as orbicular jasper
Labradorite	6	2.5	Gray, with blue play of color	Opaque glassy	Med.	Excellent play of blue color. Labrador, Canada 6
Lapis lazuli	5½	2.6	Deep blue or green-blue	Opaque to translucent-glassy	High	Cheap specimens usually in gray matrix 7
Malachite	3½	3.8	Bright green	Opaque glassy	Med. to high	Often banded or with radial fibrous structure
Moonstone	6½	2.6	Translucent white	Translucent glassy	Med.	Usually double cut to display marked opalescence 8
Opal	5½	2.0	Various. Usually white or black	Translucent glassy	High to v. high	Precious varieties show beautiful play of colors 6
Petrified wood	7	2.7	All colors	Translucent waxy to glassy	Low	Also agatized wood. Interesting patterns, nice colors
Rose quartz	7	2.6	Pink	Translucent glassy	Med.	Often opalescent. Valuable when asteriated 9
Sagenite	7	2.6	Red-brown hairs in clear quartz	Transparent glassy	Med.	Also rutilated quartz or Venus's-hairstone
Smithsonite	5	4.2	Green or blue	Translucent glassy	High	Nice color. Green variety also known as bonamite
Tiger-eye	7	2.6	Yellow-brown, sometimes red or blue	Opaque glassy	Med.	Chatoyant. Principal locality, South Africa 5
Thomsonite	5	2.3	White, gray, red or brown	Transparent to opaque-glassy	High	Popular with mottled or eye markings in red or green
Turquoise	6	2.6	Green to sky blue	Opaque waxy	High	Sky blue color is most desirable
Variscite	4½	2.5	Apple green to blue-green	Translucent to opaque-glassy	Med. to high	Cheap specimens in slate gray matrix 7

NOTES

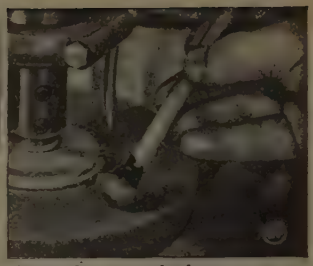
1. Based on the ability of one mineral to scratch another. See Mohs' scale above. No. 7 will scratch No. 6, etc.
2. Some variation in color should be expected.
3. Glassy indicates luster of glass; Waxy, somewhat lower.
4. Most gems listed are inexpensive. Low indicates 2 oz. for 25 cents, from which you can cut three or four ring-size cabochons. Medium, 1 oz.; High, ¼ to ½ oz.; Very high, less than ¼ oz. for 25 cents.
5. Chatoyant—a rippling play of light on the surface of the stone. Some effect often seen in wood.
6. Play of color—a changing play of color on the surface or interior of stone. Most pronounced in opal, which shows flashes of red, blue, green and other colors.
7. Matrix—the slate, shale or other material in which some gems are found. Sometimes attractive, usually not.
8. Opalescence—a play of light without color inside the stone. Most pronounced in moonstone.
9. Asteriated—showing starlike light when viewed under good light. Star rubies and sapphires are best examples.



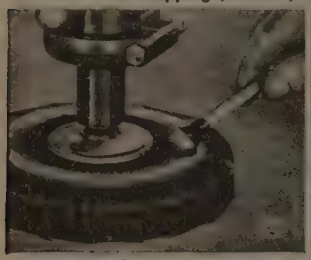
5—Grind outline and shape roughly on 100-grit wheel. Use plenty of water. Speed 1200-2400. Watch out for chipping (see text)



6—Cement the stone to a dowel stick. Use regular lapidary cement. Both stone and cement must be hot for good adhesion



7—Further smooth the stone, using 100 and 220-grit wheels in succession. Keep wheel wet to avoid burning. Speed 1200-2400



8—Dry-sand on 220-grit cloth backed with felt on wood wheel. Speed 1200. Use moderate pressure, but avoid getting stone hot

9—Mix polishing abrasives with clay flour and water to form a paste. Use F-grit silicon carbide for first polish; tripoli for final

10—Polish on felt wheels. Keep wheel wet with tiny trickle of water. Speed 1200. Use moderate to heavy pressure (see text)

(magnetite), which is strongly magnetic; Iceland spar, which shows two images of anything viewed through it; selenite, which can be bent without breaking.

Cutting materials: Minerals suitable for cutting because of their color or sparkle are called gem stones. A selected list of cutting materials is given in Fig. 11; most of these are inexpensive and readily obtainable. These stones are intended for cutting en cabochon. Cabochon gems usually are round or oval, but may be almost any shape, Fig. 6, so long as they are not facet-cut like diamonds or other transparent stones. Cutting material includes all minerals which look attractive when cut and polished; you can pick up pebbles from any beach that will rate as semi-precious gem stones. Most popular with beginners are agate, petrified wood, tiger-eye and jasper. All of these except tiger-eye occur in a wide variety of brilliant colors and markings so that a good collection can be based on these alone. The most expensive stone in the list is opal. There are cheap varieties of this—common opal—but gem quality indicates a stone which flashes red, blue and green patches of color as it is turned in the hand. A few of the stones, such as variscite, turquoise and lapis lazuli, occur in matrix; that is, the actual gem stone is embedded in a valueless mass of slate, shale or other mineral. Sometimes the matrix polishes nicely and the whole thing makes an attractive gem stone; usually, however, the matrix is not attractive.

You can buy cutting material in three forms, as shown in Fig. 10. Rough cutting stock averages one dollar per pound; sliced material costs about 50 cents for a 3 by 3-in. slice, and ready-cut gem stones about 50 cents each. It is a good idea to experiment with all three since each has its good points in money value or workability.

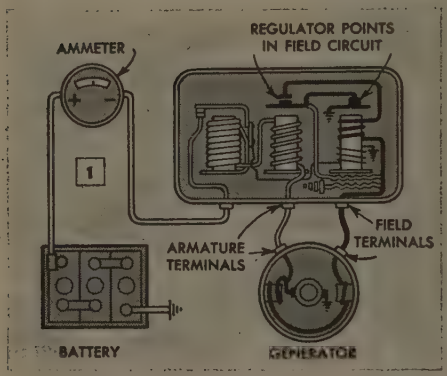
Gem cutting and polishing: Complete accessory equipment for gem cutting and polishing is illustrated in Fig. 12. Of these items, the diamond saw (diamond grains embedded in the rim of a copper disk) is the most expensive, costing several dollars in the 6-in. size. The rest of the items can be purchased at a total of about five dollars. The actual gem-cutting machine can be almost any type of motor-driven spindle. One of the best spindles for this work is a drill press. If this is fitted with a simple cooling system (water), it is ideal for the various cutting and polishing operations, Fig. 13. The only other extra equipment needed is a spindle as in Fig. 14, and even this is a standard drill-press accessory (grinding or shaping arbor). The feed pan used to hold and control splash of water can be obtained from any farm store for about fifty cents.

Figs. 15 to 24 inclusive show the cutting and polishing operations. With a little experience, it takes about 40 min. from rough stone to finished gem. Make your first job an agate. Break or saw the rough stock to get pieces suitable for gem cutting. In operation 5, Fig. 19, keep a bevel ground on the stone in advance of the side cutting. If you grind right down to the outline on the 100-grit wheel, you may chip the edges. In Fig. 20, use a stick somewhat smaller than the stone. Heat the stick and cement together over a hot plate or torch. When the cement begins to melt, twist it off onto the stick. Have the stone hot before you press it into the cement—it should be just as hot as you can hold. Good adhesion usually will be obtained if both stone and cement are hot. Moisten your fingers and mold the warm cement around the bottom of the stone, but keep it clear of the edges. Let cool 10 min. or dip in cold water to set cement. Operation 8—this is done dry. The sanding cloth should be backed with something that has a slight amount of "give." Felt is standard, but a piece of carpeting or several layers of canvas will do. Use moderate pressure, but stop frequently to avoid overheating the stone. Operation 10—use heavy pressure in the rough-buffing operation with F-grit silicon carbide grains. The felt buff must be fairly hard and of the proper combination to assure smoothness. The removal of tiny flats requires a hard buff and hard pressure. Don't try buffing with a loose muslin buff—you may get a mild degree of polish but the surface will be lumpy. Have the abrasive in a dish and apply to stone every 10 seconds. Get the stone as smooth as possible with the F-grit before you change buffs for the final polish. This can be done with tripoli or any of the special buffing powders formulated especially for this work.

It is easy to tell when the stone is polished perfectly. It has a glasslike appearance, you can see your face in it, and the image of a lamp bulb or window is bright and sharp. If it does not satisfy you, go back one or two steps and try again. Never rush the polishing schedule; never say, "I can take that out in the next operation." What you can do in a few seconds by sanding takes several minutes on the buffing wheel.

Other tool setups: You can grind and cut gems on almost any kind of spindle. The lathe, the bench grinder, and buffing heads can be used. If you have a belt sander, use it with a 220-grit belt, as in Fig. 26. Round cabochons are ground readily with a lathe; cement the stone to a metal rod, then grind with a hand grinder, Fig. 25, and polish with a rag and abrasive with the lathe in motion.

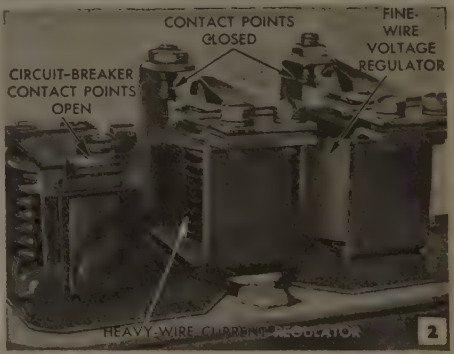
GENERATOR REGULATOR SERVICING



UNDER the hood of every modern car you will find mounted on the fire wall or on one side of the motor well what appears to be an insignificant little metal box into which wires enter. Housed inside the box is the generator regulator on which depends not only the life of the battery and generator but, to a great extent, the operation of your car. The regulator controls the flow of current (amperes) and the voltage (pressure) produced by the generator, thus preventing overcharging or undercharging of the battery, or possible burning-out of accessories or the generator itself.

As pictured in Figs. 2 and 5, the regulator consists of three instruments—the circuit breaker, current regulator and the voltage regulator. All three instruments are merely relays, two of which—the current and voltage regulator—open and close the generator field circuit. In reality, the circuit breaker is an automatic switch, which opens the generator-charging circuit when the generator is inoperative, or when the voltage output is below that of the battery. This prevents discharging the battery back through the generator.

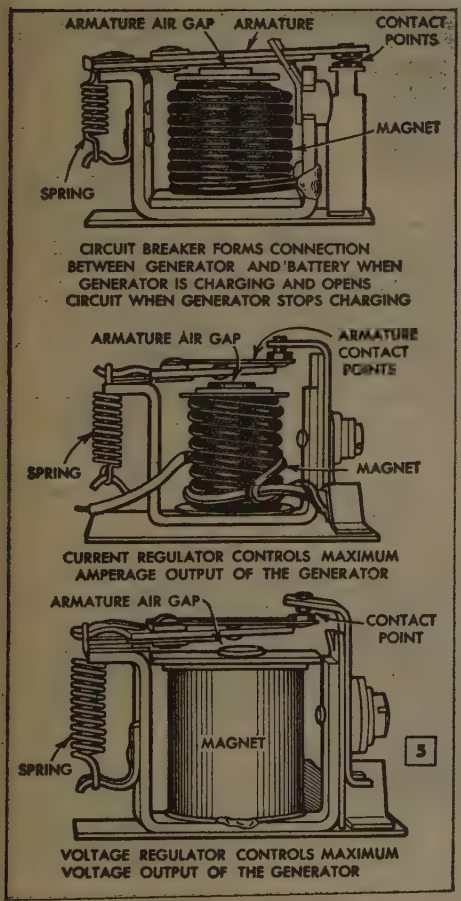
You will notice one of the two remaining instruments is wound with heavy wire and the other with fine wire. The heavy-wire instrument is the current regulator and the one with fine-wire winding is the voltage regulator. Space does not permit a complete description of construction, but



Above, a popular-type regulator having an automatic circuit breaker. Unit with heavy wire is the current regulator, one with fine wire is voltage regulator. Below, resistances on back of the regulator control field strength and, consequently, generator output

4

Be sure battery cables and posts are not corroded. Brighten with sandpaper and then apply baking soda



a study of Fig. 1 will show the generator wiring through the regulator to the battery. Modern generators are shunt-wound, that is, the field coil is connected directly across the main brushes. From the brushes, the charging current flows to the battery. However, the field coils are connected into this circuit, too, and the amount of current flowing through them determines the output of the generator. Increasing the flow of current into the field increases the generator output and decreasing the flow reduces the output. In Fig. 1, the heavy dark line is the field circuit and the lighter, small line is the armature or output circuit. Notice that the armature circuit goes through the coil of the current regulator—the center instrument—on through the coil of the circuit breaker and then to the battery. The field circuit flows through the breaker contacts of both the current regulator and the voltage regulator to a ground. However, the field circuit also is wired to by-pass the contact points when they are open and pass through resistances, which may be pieces of carbon or resistance wire as shown in Fig. 3.

In normal operation, the contact points of the current regulator are closed but, should the generator output go above a given amperage, the coil, which is an electromagnet, exerts sufficient pull to open the contact points, thus causing the current to flow through the resistance and reduce the current flow into the field coils. This immediately reduces the generator output. This cycle repeats many times per second when the current regulator is in operation.

The voltage regulator works in a similar manner except that it controls the voltage. When the amperage output of the generator increases, the voltage also increases. Therefore, it is necessary to control it, too, otherwise, the lights and accessories might burn out. This regulator is wound with fine wire, which will allow only a given voltage to pass through it. If the voltage increases beyond this point, the magnetic pull of the coil causes the points to break as in the current regulator.

Although most major servicing of the regulator units should be left to an experienced mechanic, a knowledge of how the regulator works will enable the motorist to detect impending trouble and, in some cases, make the necessary repair.

A quick check of regulator operation can be made by watching the charge indicator on the instrument panel. With a fully charged battery, a very low charging rate is normal. A fully charged battery and a high charging rate indicate trouble, which may include a defective voltage regulator, incorrect setting, or a ground at the generator field terminal or in the wire from

the latter to the field terminal of the regulator. Also, a poor regulator ground connection may be causing the trouble. You can check this by connecting the regulator frame to the frame of the generator as in Fig. 6. If this reduces the ammeter reading, clean and tighten the regulator base. A high charging rate is normal for a "low" battery, but a low charging rate for the same battery indicates trouble which may be due to one of the following conditions: 1. Loose, corroded or damaged wires. 2. Faulty battery. 3. High resistance in charging rate. 4. Low regulator setting. 5. Burned or rough contact points. 6. Faulty generator. After cleaning and tightening the connections in the charging circuit, Fig. 4, check the generator by grounding the field terminal with a jumper wire or screwdriver. If the charging rate increases, the fault likely is in the regulator or wiring.

However, most regulator troubles are caused by oxidized or burned contact points, or weak spring tension. Only a fine-cut file like the one in Fig. 7, which is called a spoon or riffler file, should be used.

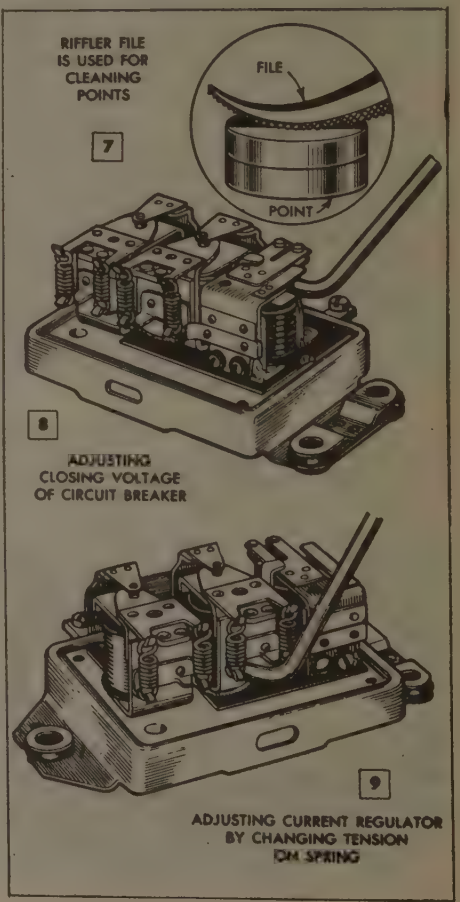
Before the points are cleaned, check the air gap between the core and its moving arm or armature with a feeler gauge for resetting the gap after filing the points. The same spacing or gap must be maintained as the magnetic influence diminishes with an increase in the air gap.

After servicing the regulator, Figs. 8 and 9, adjust the spring tension on the points, checking the final operation with the cover in place, as it forms part of the magnetic circuit in some regulators. Before adjusting the tension, allow the generator to charge 20 or 30 min. to establish a normal temperature. Newer regulators have a bimetallic arm which stiffens when cold to increase generator output until the unit warms up. After adjustments have been made, check the circuit breaker to see that it opens and closes correctly. Increasing spring tension on the cutout points will delay closing, decreasing it speeds closing, Fig. 8. Hold the voltage-regulator points firmly together and accelerate the engine to see if the current regulator limits the maximum output of the generator to a little less than a full-scale reading of the car ammeter.

With all connections in the charging system clean and tight, and the battery in good condition, only the slightest charge should show on the car ammeter, possibly three amperes. If the rate is greater than this, reducing spring tension on the voltage regulator points will lower the rate. If the generator is showing no charge whatever, a slight increase in the spring tension will usually produce the preferred charging rate.

6

Regulator and generator frames connected together with copper wire determine poor ground connection

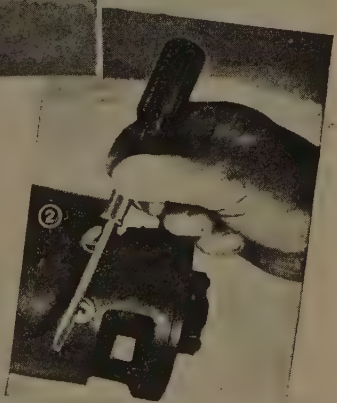


GENERATOR SERVICING

IT'S USUALLY some little thing that makes a generator stop working. Failure generally begins when the ammeter needle flickers to zero and back.

First, you want to know whether the trouble is in the generator itself or in the regulator, which controls the output. Before attempting this check, it is necessary to know if the circuit between the generator and the battery is complete, which may be determined by closing the cut-out points and noting the ammeter reading. With the engine at rest, the discharge indication will be between 15 and 20 amperes. Two simple tests are made. With the motor running at an approximate 20 m.p.h. road speed, and without having disconnected any wires, hold a screwdriver across the field terminal and the generator frame as in Fig. 1, being sure to make good electrical contact. This completes the field circuit in those generators in which the field is connected internally to a "hot" brush and has but to be grounded to give maximum output. If the ammeter shows charge when this is done the trouble is outside of the generator. If no charge is indicated the generator may be at fault, which is further checked by a second test on generators having separate field and armature terminals; these being connected together as in Fig. 2. This test completes the field circuit in generators that have a field grounded within the generator but which must be connected to the main brush to receive current. Continued

If the ammeter needle flickers from charge to zero, trouble is brewing. Perhaps the commutator must be turned down and the insulation between the bars must be undercut



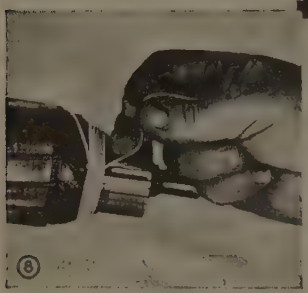
To check generator, after making sure that circuit to battery is complete, start the motor. Then, without disconnecting any wires, first ground field terminal on some generators, Fig. 1; on others hold screwdriver across terminals, Fig. 2. If ammeter does not show charge, generator is faulty

With a bent wire, you can lift out the brushes to see if they are stuck in the holders or whether they are worn down too far and should be replaced with new ones

When necessary to remove the generator, the end cap to which the brush holders are attached is slipped off and the insulation of the insulated brush holder is examined as in Fig. 5 to see if there is a short circuit. Slots between commutator bars are scraped and brushed clean, Fig. 6, as carbon dust may cause a short circuit across them

Sometimes damage to insulation on armature coils where they connect to the commutator, can be repaired satisfactorily by wrapping it with cord as shown in Fig. 8. After the wrapping is completed the cord is given a thorough soaking with shellac and allowed to dry

When new brushes are installed at the time a generator is dismantled, you can make the contact surfaces of the brushes conform to the curvature of the commutator by rubbing them on fine sandpaper wrapped around the commutator and held with cord as in Fig. 9



To wrap a wire having broken, double the cord, lay the doubled portion lengthwise on the wire, and while holding the end of the cord with one finger, start wrapping from this end toward the loop. When you get there, slip the loose end through the loop and pull the other end so the loop closes and grips the loose end tightly

failure to charge indicates a defective generator but if a charge is shown the trouble is elsewhere.

When it is known that the generator is defective, stop the motor and examine the brushes. Lift them up as in Fig. 3, with a wire or buttonhook bent to an L-shape at one end. Perhaps the brushes are stuck in the holders. Then lift the retaining springs and remove the brushes as in Fig. 4 to see if they are worn down too far. Usually brushes should be replaced after approximately 15,000 miles of car service. Should there still be no indication of charge after replacing the brushes, remove the generator from the car.

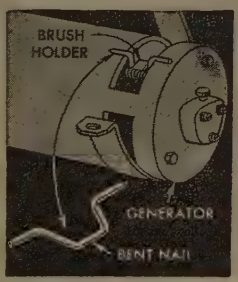
Now, with the brushes lifted from the commutator and held in place by side pressure of the brush springs, the wires to the brush holders are disconnected and the cap that carries the brush holders is removed from the generator. A frequent cause of failure is excessive oiling, which soaks insulation and retains carbon dust that comes from the brushes, causing a short circuit. Examine the insulation of the insulated brush holder as in Fig. 5, to see if it has been charred. If in doubt whether this insulation is defective, make a test with a light. Short circuits between the copper bars of the commutator are common. Here again, oil holding carbon is often the prime cause. It is not enough to clean a commutator with a rag or fine sandpaper as this gives only temporary relief. You should scrape and brush all dirt out of the slits between the commutator bars as shown in Fig. 6. If the commutator is rough and looks as if it has been burned, and if the insulation between the bars comes flush with their surface or projects slightly, the commutator should be turned down in a lathe as lightly as possible, and the insulation between the bars should be undercut.

Next to brush and commutator troubles,

the most common causes of failure are short circuits, open circuits and grounded circuits. Often the trouble is due to wires rubbing on the armature. Bared wires should be re-insulated by wrapping them with cord but the wrapping should not be more than 2 in. long. Should more wrapping be necessary, put it on in sections of 2 in. or less. Fig. 7 shows a wire wrapped and the accompanying caption tells how this is done. Shellac on the wrapping will stiffen the wire so that it will not sag down against the armature. Tape should not be used inside a generator as it may loosen and cause serious trouble. If you notice that the armature coils are in any way damaged where they connect to the commutator bars, you can re-wrap the wire with cord as shown in Fig. 8, after which it is thoroughly shellacked. If new brushes are installed when the armature is removed from the generator housing, the brushes are sanded down to the proper curvature on fine sandpaper wrapped around the commutator as shown in Fig. 9.

Nail Holds Brush off Commutator When Working on Generator

When working on an auto generator, either to dress the commutator or get at other parts for removal, it's difficult to keep the commutator brushes out of the way, but by slipping a bent nail under the brush holder, it's no trick at all. Although the brush-holding device varies with different types of generators, a nail bent somewhat as shown will be suitable in most cases.



Seed Germination Percentage

The germination percentage of seeds can be determined easily by first punching small holes in a piece of insulating board and forcing a seed into each perforation. Then place the board in a shallow pan containing water. Add sufficient water from time to time to keep the insulating board damp. Percentage can be figured from the number of sprouts.

IT'S what's in the gift package that counts, of course, but there's no getting away from it—the wrapping leaves the first impression. Nothing takes the edge off lively anticipation quite so much as a messy, hard-to-undo package. Colorful ribbon, suitable paper in gay shades, glue, seals and a little time are all you need to turn out a neat, attractive job. The first important step is to get the paper wrapping cut to exactly the right size. Details A and B show the proper procedure. Use glue or a seal to hold the center seam, B. Glue usually is best as it makes a hidden seam which is especially effective on lined, checked or plaid papers. However, be careful not to use too much as it has a tendency to penetrate the paper. Glue or seal-fasten the flaps as at D, first making sure that the folds are neat and sharp and without wrinkles.

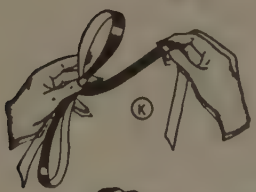
Details E to H inclusive suggest four package ties which are most effective on flat, rectangular boxes, although with slight variations they can be used on packages which are more nearly square. For best results, bows are made separately. The attractiveness of a bow depends on the number of loops and the way they are arranged. How to begin a loop is shown at the left in detail J, while details K, L and M outline the successive steps.

After sufficient loops have been formed for the type of bow desired, excess ribbon is cut off and the bow is laid on top of the package and tied securely. Ends of the ribbon tie need not be knotted over the bow unless the ribbon used has a tendency to slip. The irregular loop bow is easily made by varying the lengths of the loops and tying them in the center with loose ends of ribbon, which are left for this purpose. This method also can be used for an elongated bow except that the loose ends, instead of being fastened in the center, are tied nearer to one end of the group of loops. The dahlia bow consists of loops which have only slight variations in length. After the bow is tied to the package, the loops are cut diagonally to produce a petal-like effect. The French bow has loops of identical lengths, but they are placed sidewise and tied to obtain a fanlike effect. The carnation bow is composed of two separate bows with the bottom loops longer than those on top. Each unit is tied with thread before placing on the package. Besides using tricky bows like those described above, professional wrappers call further attention to packages by using ribbon that contrasts with the decorative paper wrapping and ornaments appropriate to the occasion of the gift. These are inserted in the fastening of the bow.

GIFT WRAPPING

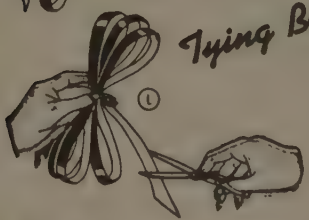
CARNATION BOW

IRREGULAR LOOP



FLAT BOW

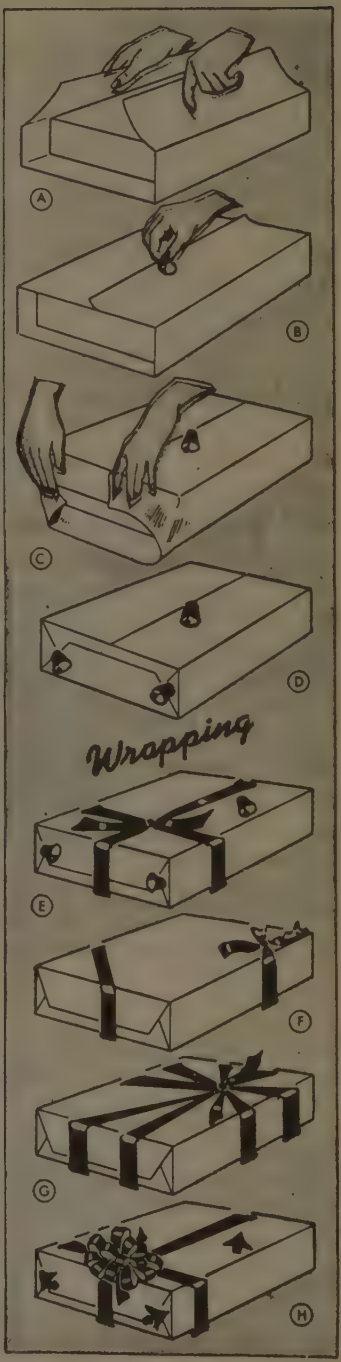
Tying Bows



FRENCH BOW

ELONGATED BOW

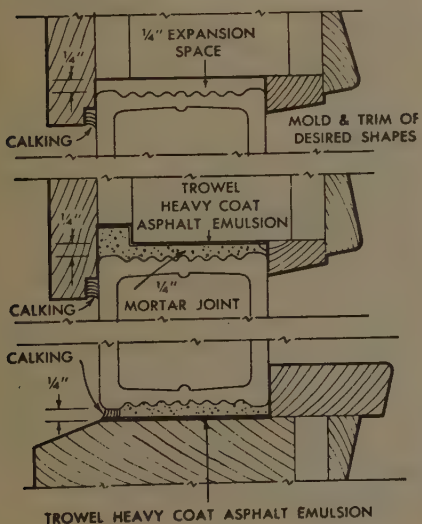
DAHLIA BOW



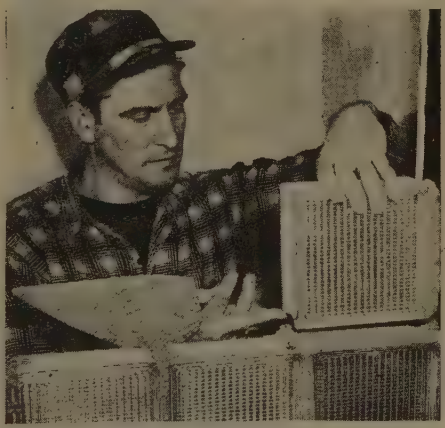
GLASS BLOCK INSTALLATION

HOMEOWNERS planning to install small decorative glass-block panels in an exterior wall will be happy to know that the manufacturers of structural glass block have developed a simplified method of installation which eliminates the need of expansion strips and wall ties. Instead, an asphalt emulsion is used, and an expansion space is allowed above the top row of blocks as in the upper detail. The opening must be framed in the same way as for a double-hung window, with adequate lintel support at the head, and it should be not more than 5 ft. wide or 7 ft. high, including a maximum of 25 sq. ft. The first step is to brush a heavy coat of asphalt emulsion onto the wooden frame, applying it in a strip about 3½ in. wide across the sill, lower detail, and up the jambs, center detail. The blocks are laid up in ¼-in.-thick mortar joints consisting of portland cement, 1 part, hydrated lime (high-calcium type), 1 part, and graded plastering sand, 4 to 6 parts. Trowel the joints neatly and, when finished, scrub the panel to remove all excess mortar. Scrape out any loose mortar from the expansion space at the head and finally run a line of calking completely around the opening.

CROSS SECTION OF GLASS-BLOCK WINDOW

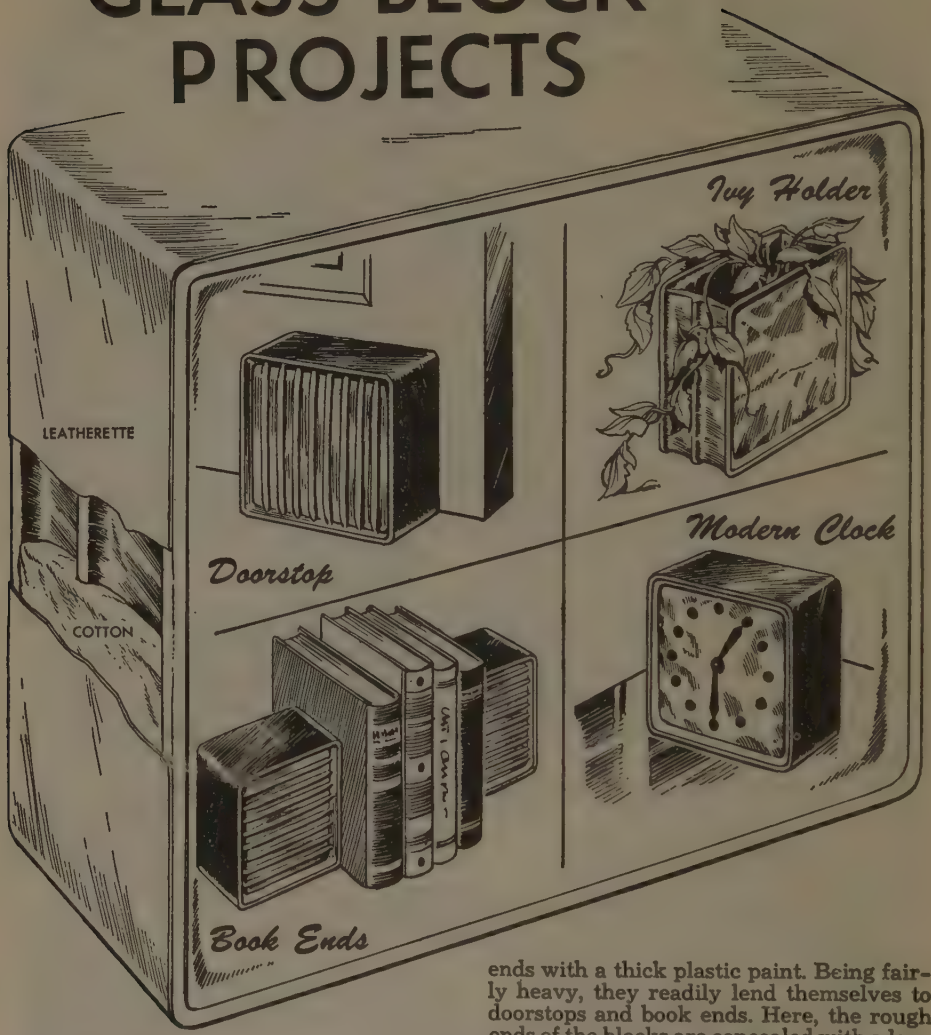


Apply a heavy coating of asphalt emulsion to the sills and jambs. The coating should be at least 3½ in. wide



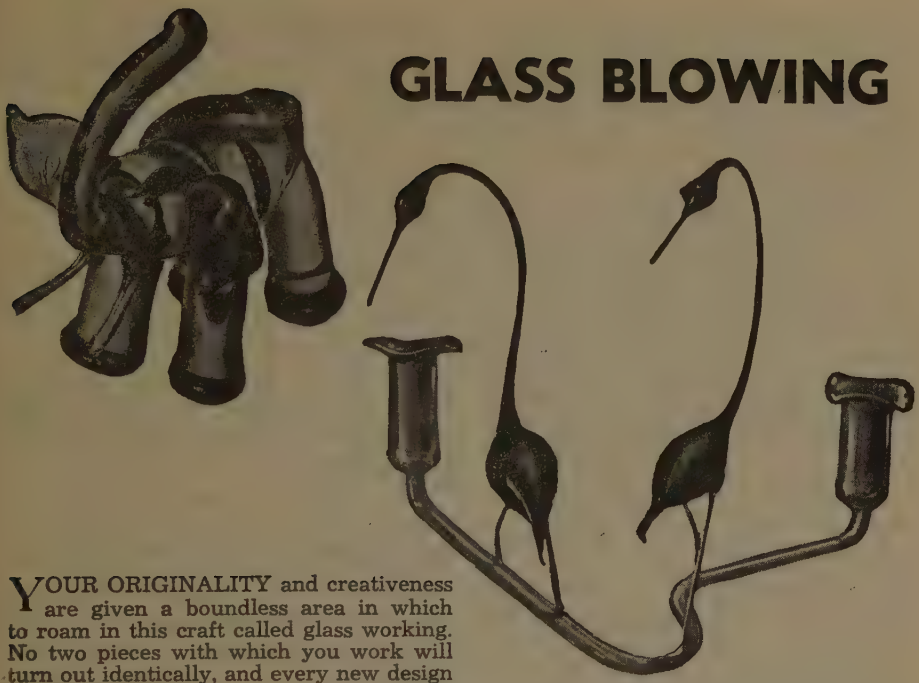
Above, lay the blocks in mortar joints troweled to a uniform thickness of ¼ in. Below, run a line of calking compound all around the completed panel

GLASS BLOCK PROJECTS



ALTHOUGH primarily used in wall construction, structural glass blocks in themselves provide the home craftsman with an unusual craft material—one which challenges his ingenuity. Being both decorative and inexpensive, the blocks can be put to many practical purposes, among which are the four suggestions shown above. Consisting of two hollow sections fused together, the blocks provide excellent and smart-looking containers for ivy, requiring nothing more than carefully breaking out the top and coating the rough ends with a thick plastic paint. Being fairly heavy, they readily lend themselves to doorstops and book ends. Here, the rough ends of the blocks are concealed with a layer of cotton and a wrapping of leatherette. The latter is cemented to the edges of the block, pulled around firmly and lapped on the underside. The clock-case idea involves breaking out the back of a block to take a small movement and drilling a hole through the face of the block for the hands. The drilling is done with a three-cornered file which is ground to a long tapered point and rotated with an auger brace. Putty around the hole forms a well for turpentine which lubricates the file. Numerals on the clock face are dots of paint, and the edges of the block are covered with leatherette.

GLASS BLOWING



YOUR ORIGINALITY and creativeness are given a boundless area in which to roam in this craft called glass working. No two pieces with which you work will turn out identically, and every new design presents new challenges and new problems.

Little equipment other than the means for heating the work is needed by the amateur glass crafter. Much practice, however, is required by the amateur to get the feel of the different operations and the eye for judging the flame. Watching an experienced glass worker and listening to his advice may save many hours of futile experimenting.

Materials: Glass rod and tubing, sold in 4-ft. lengths, are the materials with which the amateur glass worker is to work. The diameter is measured on the outside in millimeters, with 25 mm. being approximately equal to an inch. Six to 15-mm. tubing will be found to be the most useful in the homeshop, although a few pieces of smaller rod and tubing may be needed for such jobs as the eyes on animals.

Glass tubing should be stored flat and dust kept out of it. The different types of glasses, each having its own individuality, should be kept apart. The home worker will do well to use one type all the time.

Types of glasses: Boro-silicate glasses, such as *Pyrex*, are known as "hard" glasses. A high heat requiring oxygen mixed with the fuel is needed in working with them. These glasses are used extensively in laboratory glassware because of their resistance to sudden change in temperature and chemicals. The need for oxygen and the price, which is about double that of "soft" glasses, deter wide use of hard glasses in home workshops. Apart from these drawbacks *Pyrex* is no more difficult to work with than other glasses and has a beautiful luster.

"Soda" glass is the soft glass most commonly used. If you ask for soft glass in a chemical supply house, this is the glass you will probably get. It expands rapidly when heated and will crack if introduced quickly into a flame. Soda glass, or soda-lime glass, is about the cheapest and easiest glass to obtain.

"Lead" glass is used a great deal by the neon-sign industry. If there is a neon-sign shop in your neighborhood, its waste bin will supply you with a year's stock of glass. Colored tubing in this type of glass is available, and a great deal of heat can be applied to it at once. These factor, make lead glass a favorite with some workers.

Equipment: Glass working's first rule is — be comfortable. This means that the workbench and chair (most work is done sitting) should be matched for height so the forearms rest without strain. The top of the worktable should be covered with asbestos about ¼ in. thick. Keep scraps of asbestos for workrests and other uses. A lip around the workbench, except where the arms rest, will keep things from falling off, thus avoiding unnecessary breakage.

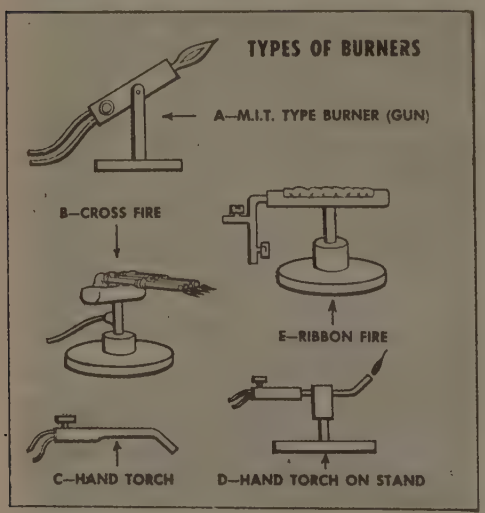
The type of burners you use will depend

on your pocketbook and the choice of glass. The cross-fire burner, for instance, is ideal for quickly heating lead glass but would instantly crack any piece of soda-lime glass. The M.I.T. gun-type burner is ideal for *Pyrex* (with oxygen) or soda glass. Air and gas supply in all burners should be adjusted separately.

Sooner or later the need for a hand torch will arise. An operation such as "spot welding" could not be done with a hand torch. The Type 3 A Blowpipe, manufactured by the National Welding Equipment Co., or equivalent will be found very convenient and comes with several nozzles. A laboratory stand can be used to hold this torch, thus converting it into a gun burner. If this arrangement is used, one has a hand torch and a gun burner for just a little more money than an M.I.T. burner alone costs (around $10). Cross-fire burners retail around $30 unless they are homemade.

Ribbon burners are useful when complicated bends have to be made in tubing as in making letters for neon signs. These burners are expensive but can be easily improvised by cutting a slot (½ in. wide) in the top of a 1½-in. pipe and placing fine wire mesh over the opening. One end is closed off; the other end admits the gas-air mixture.

The fuel can be city gas (natural or coal). Where this is not available, bottled gas sold under a variety of trade names (Butane, Propane or a mixture of the two) can be used. However, the usual regulator — a pressure-reducing device—has to be used. Whatever the fuel, a foot-operated switch which cuts the fuel supply to a pilot flame when the burner is not actually used will soon pay for itself in the fuel saved.



Low-pressure air is mixed with the fuel for working the soft glasses. Foot bellows are not recommended since it is difficult to keep one's hands steady while working these bellows. A small compressor like that used for spraying is the best arrangement provided the air goes first in a fairly large tank to even out the pressure. Very little pressure is needed, but it must be steady. If the flame "breathes" the pressure is not even.

Where oxygen is used, the pressure has to be reduced to about 8 lbs. You can probably get the supplier of the oxygen — whether bottled gas or the city gas company—to help you with the setup.

The light over the workbench should not be too bright as this makes the flame and the color of the glass hard to judge. Special goggles are made for glass working which absorb the intense yellow color of the ever-present sodium.

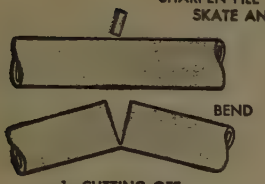
Tools needed are very few. A flat file, a pair of tweezers and scissors can probably be found around the house. A carbon rod about 8 in. long and ¾ in. in diameter is used by some workers for flaring and similar operations.

A supply of corks of different sizes will come in handy. Some glass workers blow directly into the work; others use a rubber tube held in the mouth and connected to the work with a swivel which permits rotating the work and blowing when needed. You can get these materials at any laboratory supply house.

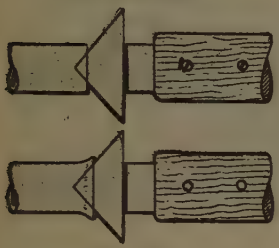
Basic operations: Before any serious work can be done in glass working the technique has to be mastered. Holding a piece of glass tubing in a flame may sound like a simple operation, but it must be realized that the work has to be revolved constantly. This means that both hands have to rotate the tube at the same rate. This is an easy thing to do as long as the tubing is cold and solid. However, when it gets soft in the flame that's another matter. If you are right-handed it may take some painful practice to learn to turn with your left hand. And the left is the turning hand in those operations where the right one is busy. Experienced workers do not burn themselves. If the end of a tube gets hot, it is a sign that you are holding the tube at right angles to the flame which then travels up inside the tubing. If you want to blow directly (without rubber tube and swivel) make sure that the end is smooth and cool. For direct blowing, a right-handed person will have to hold the right hand palm up since it is almost impossible to get it to the mouth if the hand is held palm down.

Cutting off glass tubing up to 20 mm. is done with a single stroke of a file and bending with both hands in the direction which

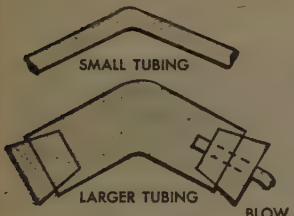
BASIC OPERATIONS



1. CUTTING OFF

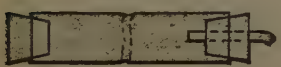


2. FLARING



3. BENDING

A—HEATING ENDS



B—PRESS TOGETHER AND FUSE

C—BLOW SMALL BULB

D—PULL TO REDUCE BULB

JOINING TUBES OF EQUAL DIAMETER

FLARE SMALLER TUBE

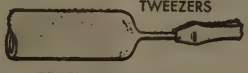
PROCEED AS ABOVE

JOINING TUBES OF UNEQUAL DIA.

4. JOINING

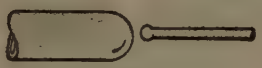
DRAW IN MIDDLE OF TUBE

HEAT UNTIL GOB FORMS

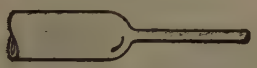


REACH INTO GOB AND PULL OUT WITH TWEEZERS AT END OF TUBE

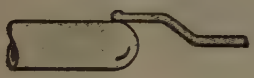
5. DRAWING OUT AND SEALING



HEAT BOTH PIECES

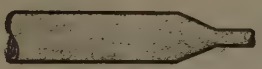


PRESS TOGETHER, FUSE, THEN GENTLY PULL APART



CRANKED SPINDLE

6. JOINING, ETC.



A—DRAW OUT

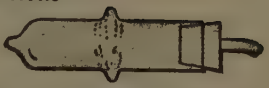
B—BURN END OFF

C—REHEAT

D—BLOW SMALL BULB

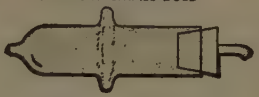
E—FURTHER HEATING AND GENTLE BLOWING

7. FORMING HEMISPHERE

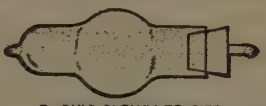


A—PRESS ENDS TOGETHER TO CREATE BULGE

B—BLOW SMALL BULB



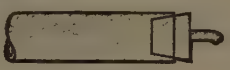
C—COMPRESS AGAIN UNTIL ENOUGH MATERIAL IS GATHERED TO BLOW BULB TO SIZE



D—BULB BLOWN TO SIZE

8. BLOWING BULB IN MIDDLE OF TUBE

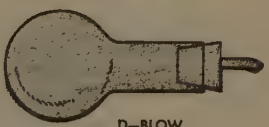
METHOD 1



A—AS BEFORE

B—DRAW OUT

C—REHEAT



D—BLOW

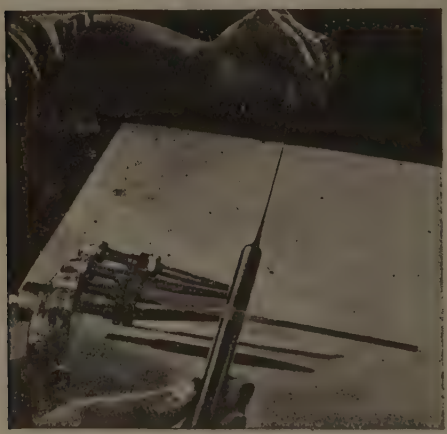
METHOD 2

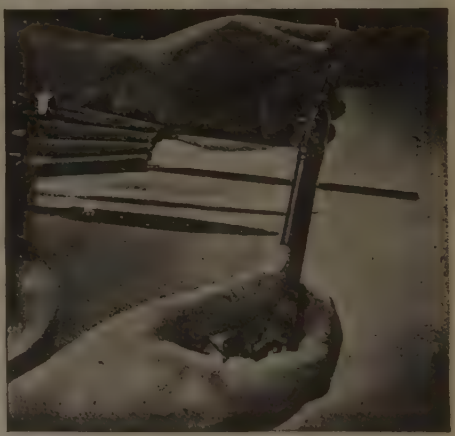
A—JOIN SHORT LENGTH OF LARGER END OF TUBE

B—SEAL OFF AND BLOW

9. BLOWING BULB AT END OF TUBE

A piece of colored glass tubing, 12 mm. in diameter, is the beginning of the bird. The first step consists in nicking the tubing with a file as shown at above left. The tubing is then bent, thus causing a sharp break as pictured at above right. Next, place one end of the tubing over the flame, remove and draw out with tweezers (below left). A bulge like that shown at below right is then formed by compressing the heated glass by pushing in





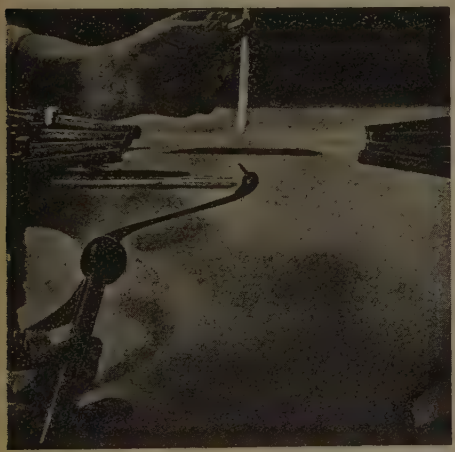
would open the crack. See detail 1 on page 8. A flat file with the narrow edges ground like an ice skate is recommended for this operation as this will give you four cutting edges which can be resharpened quickly.

Flaring is done as shown in detail 2 of page 8. The end of a piece of tubing is heated until workable while being turned continuously. The flaring tool is then inserted and work turned until the right angle is obtained. By varying the angle of the tool, and reheating if necessary, a shape like the foot of a wine glass can be made. Fluting is also done with this tool by gently pressing into the plastic glass. The top of the bird bud vase is an example.

Bending tubing of small diameter is done by heating an area several times as long as the width of the tubing. See detail 3 on page 8. The work is constantly revolved with both hands at the same speed. Bending should not start until glass has become quite luminous and offers no noticeable resistance. If too short an area has been heated, a wrinkle will develop in the bend. Bends should be completed in one smooth operation if possible and kept in one plane. Most people can gauge a right-angle bend fairly accurately but odd angles are best drawn on the workbench or a template cut. Tubing over 6 mm. requires blowing to prevent collapse just like metal tubing is filled with sand before bending.

Joining tubes of equal diameter (detail 4 on page 8) is done by heating the ends and gently pressing them together. Once the ends have fused, a light puff will raise a small bulb which is reduced by pulling the ends apart while the joint is still hot. Tubes of unequal diameter are joined by

The formation of the bird progresses as shown here. The bulb is blown as at above left. The neck is pulled out and formed all in one operation (above right). A drop off a white rod is dribbled on to form the eyes as at below left. The legs come next, as short pieces of clear tubing are attached to the body (below right)



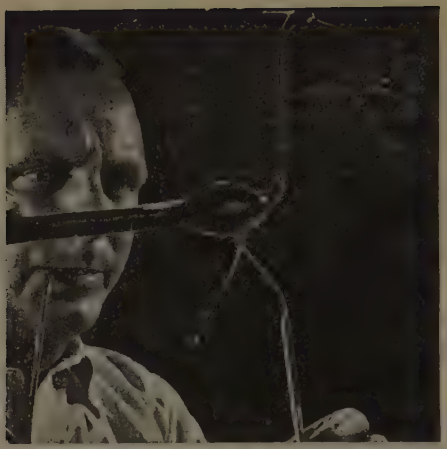
flaring the smaller tube to the approximate diameter of the larger tube.

Drawing out and sealing (detail 5 on page 8) is one of the most often used operations. Drawing out in the middle of a tube takes the place of cutting off and also provides one with a convenient spindle with which to revolve the work. Even turning of the tube is again the key to success. In the "taffy" state the pieces can be pulled apart until only a thread remains which will burn off in the frame. To draw and seal the end of a tube, heat the end until it forms a gob, then reach into the gob with tweezers and pull away straight.

Joining a rod to a piece of work (detail 6, page 8) is an often-performed operation. The lower photos on page 10 show some uses of this operation. When in the finishing stages of making an article not straight or conveniently small a cylinder is left by which to revolve the work. A rod is then welded on as a temporary spindle or "punt." The cranked form will often be found the most convenient.

Rounding the end of a test tube is shown in detail 7, page 8. The tip left from sealing off is reduced to a thickening at the bottom. A slight puff will create a small bubble which on further heating, rotating and gentle blowing will take on the desired shape and be of the same thickness throughout.

Blowing of bulbs is illustrated in details 8 and 9, page 8. In the beginning only small bulbs should be attempted. But it is obvious that even a small bulb blown from a cylinder would be thinner than the mother tube. It is, therefore, always necessary to gather sufficient material to provide for



The final touches are put on the bird, as shown in these photos. After the legs are attached, they are drawn to shape as shown at above left. Then the tail is pulled out and sealed off (above right). Next comes the "spot welding" of the legs to the base, as at below left. Base is sealed off, finished bird emerging at below right

the mass of the bulb. Continuous, even rotation at all stages is absolutely essential for success. In the middle of a tube the material is gathered by gently pressing the ends together. This process has to be repeated until sufficient material has been accumulated. At the end of a tube it is often quicker to weld in a piece of larger tubing where the bulb is to be.

After these basic steps have been mastered, the duck, goose or swan shown in this article should not present much trouble. The sequence of steps is shown on page 12. Don't let a few failures discourage you and don't expect to turn out two pieces exactly alike.

Birth of a bird: This is a more ambitious project and should be attempted only by an experienced glass worker. A piece of 12-mm. colored glass tubing about 10 or 12 in. long is nicked with the file. The air-hose and swivel are inserted through a cork of suitable size. The tube is heated, sealed and drawn into a spindle which will later become the bird's beak. Lead glass was used to make the original; this is why two four-flame cross fires were used. The tube is next heated about 2 in. from the sealed end. By constantly turning with both hands at the same rate and pressing the ends toward each other, a bulge is formed after the glass has become workable. When enough material has been collected, a bulb for the body is blown. Constant rotation is, of course, necessary. Many short puffs are better and easier than steady blowing.

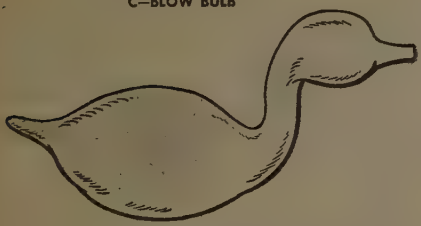
After the body is finished, the head and neck are formed by heating the part between body and final beak. The neck and

HOW TO MAKE A DUCK

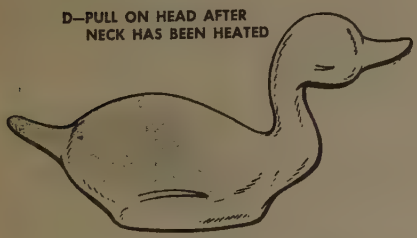
A—ABOUT 2 IN. OF 12-MM. TUBING ENDED AS SHOWN

B—CONSTRICT NEAR END

C—BLOW BULB



D—PULL ON HEAD AFTER NECK HAS BEEN HEATED



E—FLATTEN BASE ON ASBESTOS, SEAL BEAK, ADD EYES IF DESIRED

F—FINISHED PRODUCT

head are formed in *one* operation by pulling out and bending. Note that the head has not been blown but is part of the original tube. A piece of 3-mm. rod is heated to form a gob and at the same time the head is kept hot. The gob is welded to the head, the rod pulled away and the gob reheated to form an eye. If no white rod is available, a narrow strip can be cut from a sheet of opalescent white glass with a glass cutter. After both eyes and a comb, if desired, are attached, a piece of 4-mm. clear tubing about 6 in. long is heated to form a gob. The belly of the bird is heated and the leg-to-be attached and shaped. Puff at this stage to create the drumstick effect.

Next comes the sealing off and forming of the tail. If a pair of birds is being made, the piece in the right hand becomes the beak of the next bird and is ready for the operation. The legs are then "spot welded" with a hand torch to a previously prepared base of 4-mm. clear tubing 6 in. long and bent in the center to an angle of about 80 deg. One end of this tube is sealed off and the airhose attached to the other since gentle puffing and sucking at this stage helps fusion of legs to base. Note that the base is held by a weight (like an electric iron) to leave the right hand free to straighten the bird before the first weld has cooled. The hose is detached, the open end of the base sealed to keep out dust and the bird is finished.

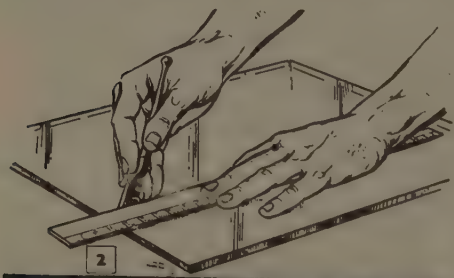
Difficulties: Glass working is a highly skilled craft and success should not be expected right away. You are bound to run into some difficulties, most of which can be traced to uneven heating. Duck-shaped bubbles, off-center cones in drawing out, wrinkles in joining tubes or bending them are a few examples. Some breaks can be traced to strains caused by joining two different glasses. On cooling they shrink at different rates resulting in strain, which may be enough to break the piece. Thin bubbles are, of course, caused by insufficient material.

Sometimes, especially with soda glasses, an opalescent ring appears a short distance from the heated area. This is due to chemical action between glass and flame. It is called "bloom" in the trade and can often be made to disappear by heating the affected area.

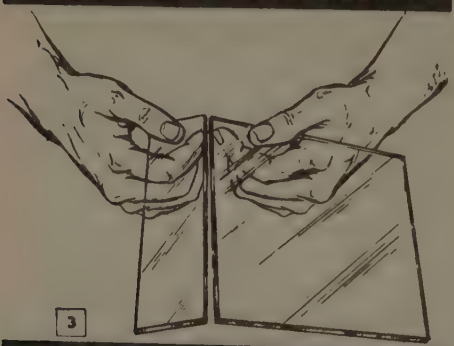
Devitrification is the name given to the cause of coarse, milky glass *in* the heated area. If it appears before working temperature is reached, it usually disappears on further heating. The same defect sometimes shows after glass has been overheated. The remedy is to start all over, using a cooler flame.

As for the care of glass pieces, don't dust them; rinse them in luke-warm water.

GLASS CUTTING



For a clean break, dip the cutter in light oil and apply kerosene to the glass before scoring



Break off scored strip 1 to 2 in. wide by placing index fingers on score and bending downward

Although often neglected, windows need frequent attention just as often as the rest of your home if they are to last and keep out rain and cold air. There is no trick in getting a first-class job done in replacing a broken windowpane. To eliminate any danger when installing a new window, it is a good idea to remove the entire sash from its frame and lay it across low supports. The broken glass is removed and the old putty is scraped from the sash. The space is measured for the new glass.

While it is true that most homeowners can have window glass cut to exact size at the store where they bought it, many times scrap glass around the home will do to reglaze a window. That's why it pays to know how to cut the glass yourself.

"If I ever tried to cut a piece of glass like that I would break it in a thousand pieces." No doubt you have heard this said before and, perhaps, have even found it so. But cutting window glass is as easy as the professional glazier makes it look, and not necessarily because his cutter may have a diamond point. It is due more to the way the cutter is held and to the tricks of the trade. With a little practice anyone can become adept at using a glass cutter and score a clean break every time.

First of all, get the feel of holding the cutter properly and recognize the sound it should make when it is actually cutting. When the tool is cutting properly, it should sound similar to paper or cloth being torn. The best way to get the feel of the cutter is to practice on an old piece of glass. Never try to cut dirty glass. Grit will prevent uniform cutting of the wheel. The glass should be placed on a flat surface. A small carpet or a piece of old rug, Fig. 1, makes the best surface on which to cut glass. Fig. 2 shows the proper way to hold the cutter. Note that it is not held vertically but at a slight, backward angle and also that the notches point downward.

To make a trial cut, first apply kerosene along the line of cut. Kerosene has been found to give "bite" to the cutter. A small brush or swab on a stick is handy to apply the kerosene to the glass. Next, using a yardstick as a straightedge, dip the cutter in light oil and start the cut at the far edge of the glass. Draw the cutter toward you with a swift, continuous movement, bearing down with a steady, firm pressure. The amount of pressure required is determined by the sound of the cutter. If it skips, pressure should be increased. Remember that the cutter actually cuts the glass and does not merely scratch it. *Never go over the same cut twice.* This is an important point to remember. Besides dulling the

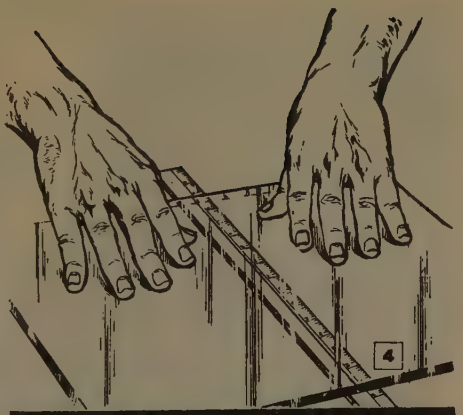
cutting wheel, scoring the glass a second time blunts the taper on the inside of the first cut and the glass will not break cleanly. For this reason, if the cutter does skip, run it over only the spots missed.

The professional glazier classifies glass as being either window glass (single or double strength) or plate glass. In cutting window glass it is advisable to use a sharp cutter as window glass, being lighter than plate glass, will not stand great pressure.

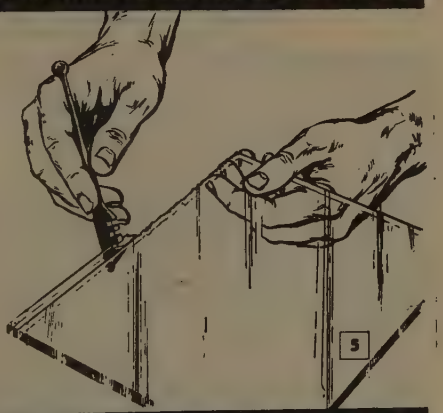
Where it is required that a strip as narrow as ⅛ in. be cut from the edge of window glass, lay the yardstick 1/16 in. to the left of the line of cut to allow for the overhang of the cutter. Next, apply kerosene to the glass where it is to be cut, using a small brush or an oilcan, and dip the cutter in oil to lubricate the wheel. If this is not done, the wheel may "freeze" when the cut is half completed and merely slide the rest of the way. To break off the strip, use the notches provided in the cutter as shown in Fig. 5, selecting the notch that fits the thickness of the glass. Don't insert the edge of the glass all the way in the notch of the cutter. The proper distance varies with the width of the strip. In most cases, strips less than 3/16 in. break off in little pieces. When breaking off strips 1 to 2 in. wide, grip the glass as shown in Fig. 3. Place the fingers and thumb of each hand close together on each side of the cut. Then, using the index fingers as pivots, snap off the waste piece by bending the glass downward with a quick twist of the wrists. To break off pieces wider than 2 in., place the yardstick directly under the cut, as shown in Fig. 4, and press downward on each side.

The procedure for cutting plate glass is the same as that used for cutting window glass. However, a somewhat different method is used to break off narrow pieces. Where the waste strip is 1 in. wide or less, parallel-jaw pliers with paper between the jaws are used to remove the strip as in Fig. 6. Strips 1 to 4 in. wide are snapped off in a manner similar to the yardstick method, except that in the case of plate glass, it is recommended that a pencil be placed directly under the cut.

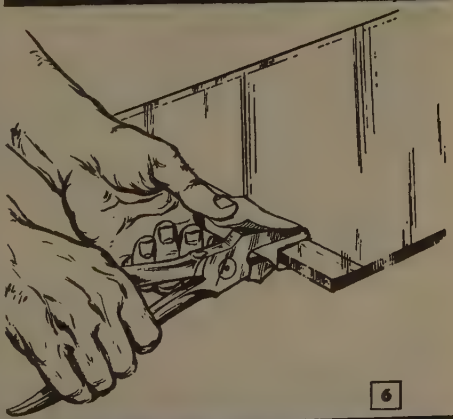
If glass is being cut for purposes other than glazing, such as a new top for a coffee table, the sharp edges of the glass may require rounding slightly. This can be done with an oilstone and water. The stone is soaked in water and then rubbed across the edge of the glass with the stone held at a 45-deg. angle. Rubbing is done with a circular motion and the stone is dipped in water occasionally as the work progresses. In polishing the edges of plate glass, the stone is held lengthwise and at right angles to the surface of the glass.



When parting large pieces, place a yardstick under the scored line and press down on each side

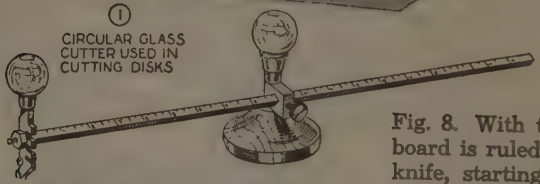


Narrow strips 1/16 to 1/8 in. wide are pried off by inserting edge of glass in notches of cutter



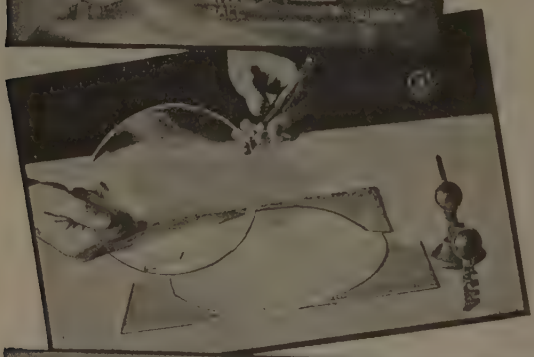
Parallel-jaw pliers provide greater leverage for removing narrow strips from edge of plate glass

GLASS

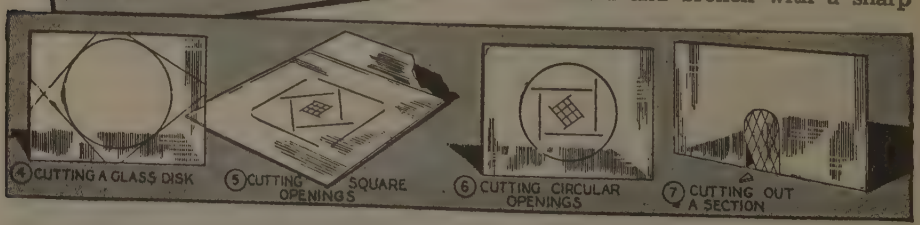


① CIRCULAR GLASS CUTTER USED IN CUTTING DISKS

FOR cutting glass, a smooth surface on which to place the piece of glass is needed. A drawing board equipped as shown in Fig. 11 has been found convenient. A hardwood strip is screwed near the bottom and a similar strip is fastened to the adjacent edge at right angles to the first strip, being held by a bolt and spring assembly at each end. The purpose of the second strip is to serve as a straightedge, the piece of glass to be cut being slipped under it and the cutter then run along its outer edge as in Fig. 8. With the two strips in place, the board is ruled off in 1-in. squares with a knife, starting at the inner edge of the bottom strip and the outer edge of the side strip. Finer divisions of the board may be made if desired.

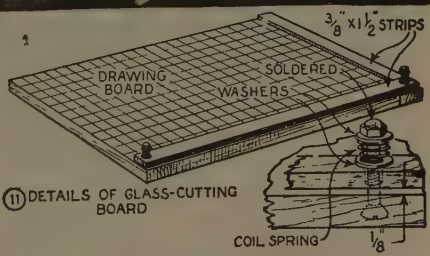


The cutter should be run over the glass only once. It is not necessary that a deep cut be made. A fine, clean but continuous line is sufficient. If it should skip a few places you may carefully run it over these places again, being careful not to retrace over any part already marked. After the cut has been made the glass should be slid forward and tapped on the underside immediately under the cut, Fig. 9. While tapping the glass you will note that a deep crack forms directly under the cut. When the crack extends the full length of the cut it should be lined up with the edge of the board and broken with a sharp



④ CUTTING A GLASS DISK ⑤ CUTTING SQUARE OPENINGS ⑥ CUTTING CIRCULAR OPENINGS ⑦ CUTTING OUT A SECTION

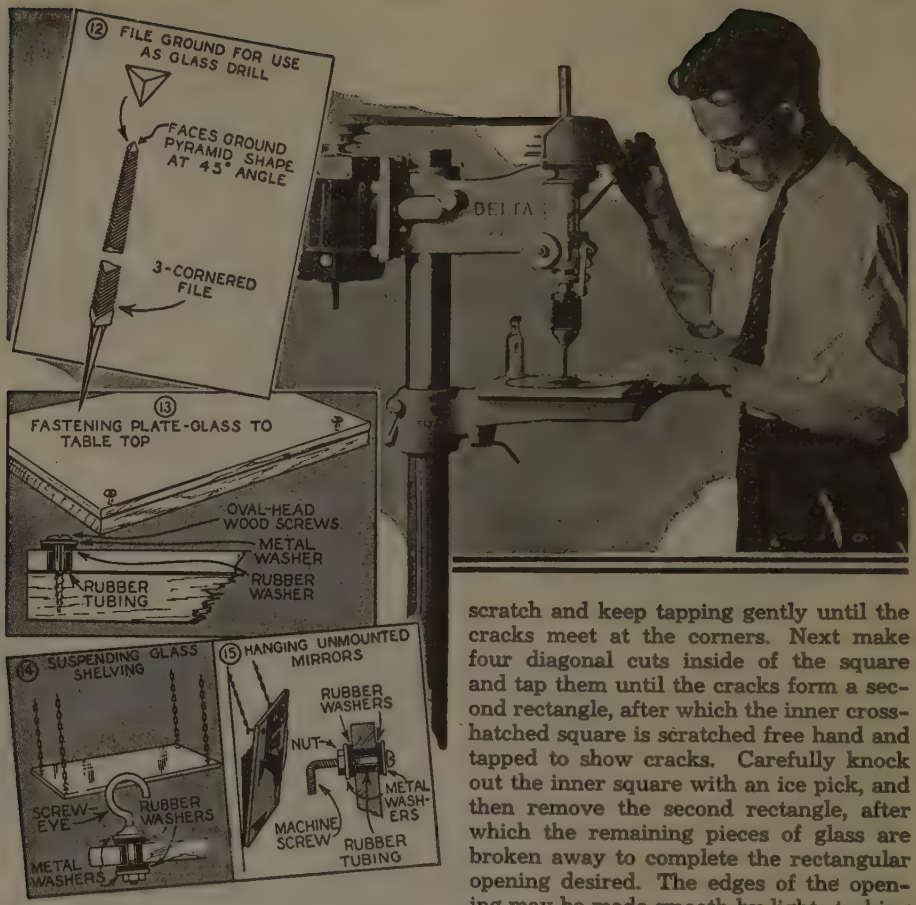
CUTTING



(11) DETAILS OF GLASS-CUTTING BOARD

downward movement as shown in Fig. 10. If the cut was perfectly straight and uninterrupted, the glass will usually break straight. However, if a few irregularities result, the surplus may be removed by simply breaking it off with the notches or teeth of the cutter. With a little practice the teeth may be used to great advantage in shaping glass. With them you can remove very small pieces without cracking the piece.

After some experience in straight glass cutting you will get the feel of the cutter and become used to the characteristics of glass. You will then be able to tackle successfully the cutting of round and irregularly shaped pieces. Round pieces of glass are cut with a circle cutter shown in Fig. 1. This cutter is mounted on a rotating arm which pivots in the center of a heavy base. When a cutter of this type is not available, a makeshift arrangement which will do the job can be improvised from a regular cutter, a short square stick, a steel ball and a small piece of rubber or tape as in Fig. 2. The cutter is held to the end of the stick by means of a tack, one of the notches being slipped under the tack head. Mark the desired radius of the cut on the stick, measuring from the cutter wheel to a point where the stick is placed on the ball. With a hammer sink the ball some distance into the wood and then lay the stick and ball on the piece of rubber, which will prevent the ball from slipping out of position. After the glass is cut it is turned over and tapped under the cut until a crack forms all the way around. Next, straight cuts are made in the glass as in Fig. 4, and the corners are



broken away exactly as in straight cutting, leaving the disk as in Fig. 3. Ovals and irregular shapes are cut out by scratching around a pattern made from ¼-in. plywood. In making irregular cuts, as much surplus glass as possible should be removed by straight cutting after the design has been scratched into the glass and a complete crack produced by tapping.

The cutting of rectangular and circular openings in glass is more difficult and requires more patience than straight cutting. It is important that only very small pieces of glass be removed at a time. Cutting rectangular openings, Fig. 5, is done as follows: First scratch the edges of the opening to be made, not marking all the way to the corners. Then tap the glass to start a crack at the center of each scratch and keep tapping gently until the cracks meet at the corners. Next make four diagonal cuts inside of the square and tap them until the cracks form a second rectangle, after which the inner cross-hatched square is scratched free hand and tapped to show cracks. Carefully knock out the inner square with an ice pick, and then remove the second rectangle, after which the remaining pieces of glass are broken away to complete the rectangular opening desired. The edges of the opening may be made smooth by light stroking with a coarse file, after which an emery stone is used for finishing. The procedure for cutting circular openings, Fig. 6, is practically the same except that a circular cut is made first. Cutting out a section of glass as in Fig. 7 is done by first scratching the arc and the straight lines, after which the inside part of the section is scratched diagonally. Cracks are then produced by tapping and the small pieces are broken out one by one.

Holes may be drilled in glass with a drill made by grinding the blunt end of a triangular file to a pyramid shape as shown in Fig. 12. The location of the hole to be drilled should be surrounded with a dam of putty. The dam is filled with turpentine to lubricate the drill, which may be rotated either in a drillpress or with an

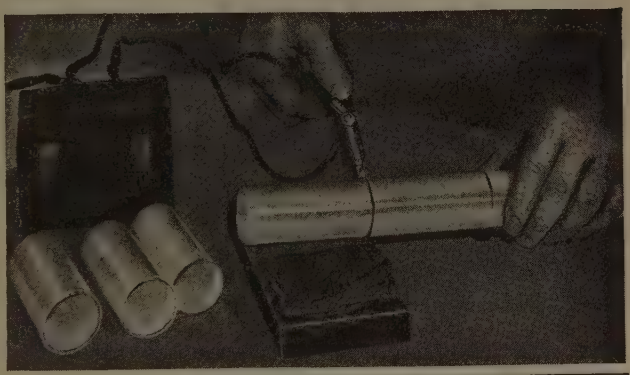
ordinary bit brace, using only a slight pressure. When the drill starts to break through, the glass should be turned over and the hole completed from the other side, very carefully, of course, to prevent breakage. If a piece of clean white paper is placed under the glass while drilling, it will be spotted by the turpentine as soon as the tip of the drill breaks through, thus warning you of the necessity of turning over the glass. Like other operations with glass, a perfectly smooth wood surface should be used as a support.

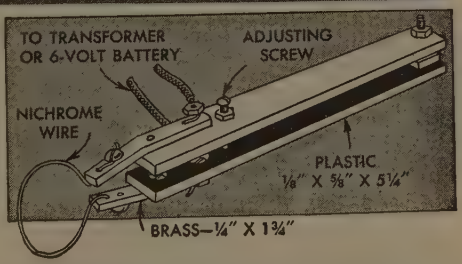
Figs. 13, 14 and 15 show methods of mounting glass. If resilient rubber mountings are not used, expansion and contraction of the glass with changes in temperature will cause breakage. These methods of mounting also make the glass less likely to break under shock and vibration.

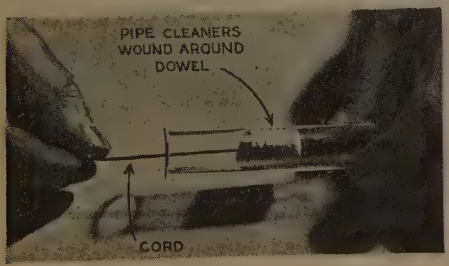
Glass may be ground smooth on a grindstone or fine emery wheel if the work is done slowly so as to avoid chipping and heating. In all operations on glass, it is important that the glass be kept from getting hot as it will break when unevenly heated. Coarse files may be used for smoothing up rough edges, if light pressure is used in quick sweeping strokes. This treatment is the most rapid method of producing a smooth edge; however, a wet grindstone is the best tool for producing a fine finish. Ground glass may be produced by rubbing the surface of glass with water and coarse emery powder on a rag or piece of leather.

Electrically Heated Wire Will Cut Glass Tubing

With a cutter like the one diagrammed at the right, which consists of a loop of electrically heated Nichrome wire fitted to a plierlike holder of hardwood or plastic, you can cut a number of lengths of glass tubing quickly. The resistance wire is taken from an electric iron, coil heater or a similar appliance. Power is supplied by a 6-volt storage battery or a toy transformer of 10-ampere capacity. In use, the loop is slipped over the tubing and pressed firmly against the glass at the point at which it is desired to make the cut, then current is applied for 4 or 5 seconds, after which the tube is touched to a wet cloth, causing it to break because of the sudden change in temperature. When using this device always remember, however, prolonged contact with the hot wire will cause the glass to melt, rendering it useless.



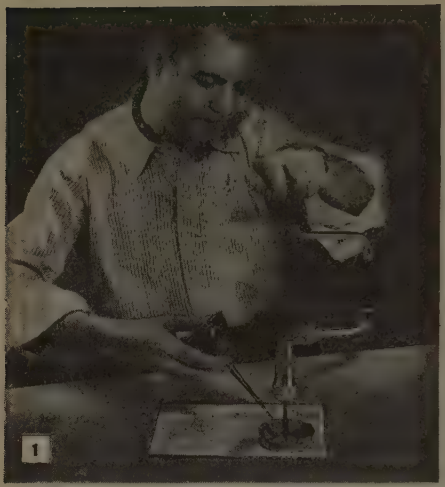




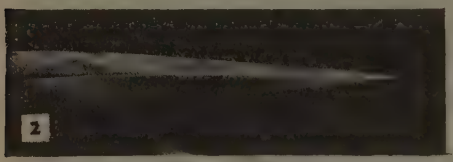
Easy Method of Cleaning Tubes

Cleaning the inside of a long glass tube is not difficult if the following method is adopted: Select a short piece of dowel that will fit inside the tubing loosely, and drill it lengthwise so that a long cord can be attached. Wind the dowel with one or two pipe cleaners, and then pull it through the tube by means of the cord.

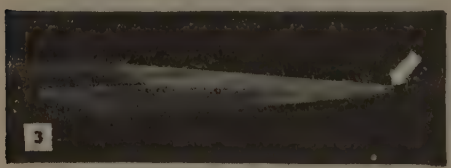
GLASS DRILLING



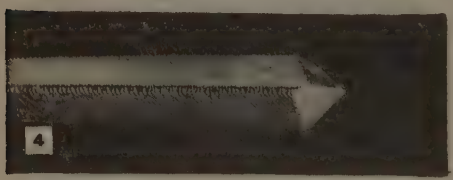
A ring of putty placed around the hole to be drilled forms a reservoir for the lubricating agent. Turpentine or camphor oil can be used and you'll find an oilcan is handy for keeping the reservoir filled



The file is brought to a long tapering point by carefully grinding each of its three sides



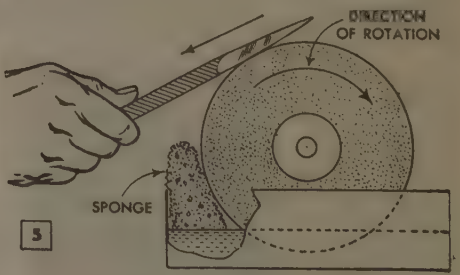
The needlelike point is squared off 1/32 in. by touching one corner to the grinding wheel

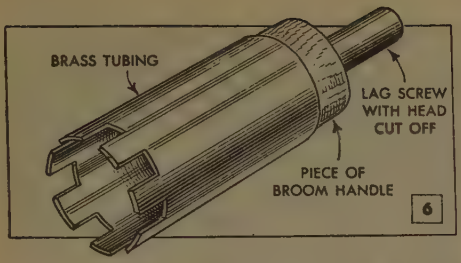


This close-up view shows how the end of a file is ground to form a tool for countersinking

Sounds difficult, but like most jobs it's all in knowing how. Ralph E. Moore takes you through the steps in drilling both small and large holes and lets you in on the tricks of the trade that make it so easy

DRILLING holes in glass sounds like a job strictly for the local glass shop. But in most cases, the tools used are common ones to be found in the average home shop. It's all in how the tools are handled that makes the difference. Drilling holes up to ½ in. in diameter does not require a special glass drill. In fact, the cutting tool is made from nothing more than a common three-cornered file. The file, of course, must be properly ground and extreme care used to avoid drawing the temper. This requires that the grinding be done on a slow-speed wheel, rotating in a water bath to prevent burning the tip of the file. The speed of the wheel should be about 300 r.p.m. and it should rotate in the direction indicated in Fig. 5. A sponge rubbing against the wheel will keep it wet and prevent splattering. In grinding the file, hold it lightly against the wheel and start grinding about 2 in. from the end. Use a sort of stroking motion, pulling the file toward you each time. This is done to each of the three flat faces and will gradually bring the tip to a needle-sharp point. After this, the point is squared off by deftly touching one corner of the file to the wheel. Note the arrow in Fig. 3. The squared tip should not be less than 1/32 or more than 3/64 in. wide. If the tip of the file discolors during grinding, it should be broken off at least ¼ in. from the end and reground. Otherwise, the temper will be drawn and the tip will not cut. A long taper point, as shown in Fig. 2, provides faster cutting and permits better control in enlarging the hole to the desired size.

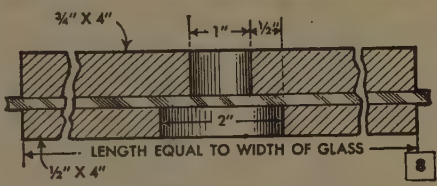




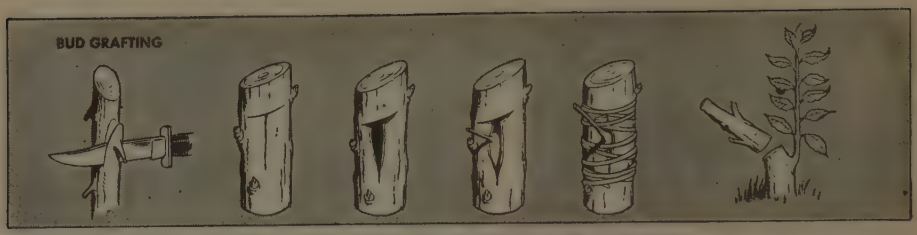
Now, let's test the cutting ability of the file. Take a piece of ¼-in. plate glass and place it on a flat surface. Holding the file vertically, press down with about 10 or 15 lbs. pressure and twist. If the tip breaks through the polished surface of the glass and makes a gritting sound, it's a good sign that the file has not lost its temper. However, if the point merely wears down without cutting, it must be reground. A file when properly ground will cut 15 to 20 holes before it needs resharpening. Where the job calls for a countersunk hole for a flat-headed wood screw, a tool is made by breaking a large-size file at the center and grinding the end according to Fig. 4. Turpentine or camphor oil is used to lubricate the file when cutting a hole. To retain the liquid, a small dam is formed of putty and placed around the hole to be drilled. Chuck the file in a regular auger brace and start rotating the brace with a firm but light downward pressure. When the drill point pierces the surface of the glass, add the turpentine, Fig. 1. An oilcan is excellent for this purpose. Rotate the brace using about 5 lbs. pressure, swinging it by the top with one hand. The needle point of the file will finally pierce the underside of the glass and when this happens use less pressure and rotate the brace more slowly. Let the glass overhang the edge of the table and continue through. If the point is allowed to embed in the table, you are apt to chip the glass on the underside. Some glaziers recommend finishing the hole from the reverse side as soon as the point of the file breaks through.

Thin glass, such as single and double-strength window glass, should be placed on a heavier piece of glass to provide a good flat surface and drilled with a minimum of pressure, little more than the mere weight of the brace. This is especially necessary when the point of the file is about to break through the work and when a hole is being drilled close to the edge of the glass.

Drilling large holes in glass requires a different technique and tools. The cutting tool required is homemade, Fig. 6, consisting of a length of brass tubing with teeth formed at one end and fitted with an accurately centered shaft for chucking it in

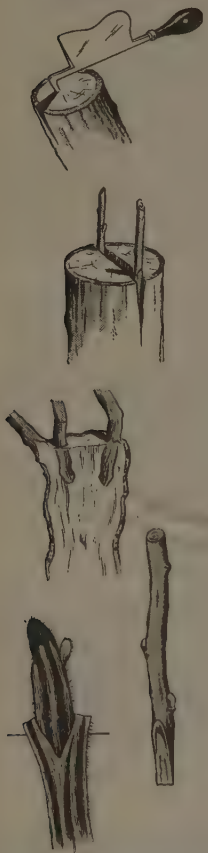


an electric hand drill or drill press. The notches are formed with a hacksaw, the pieces are broken out with pliers and then squared up with a fine file. In using this cutter, the glass is clamped between two wooden guides, Fig. 8. A hole the same size as the cutter is made in the top piece, while the hole in the bottom piece is made larger as shown. In addition to guiding the cutter, the top hole serves as a well which is filled with two tablespoonfuls of silicon carbide or emery dust and enough water to nearly fill the hole. The drill is held vertically as in Fig. 7, using from 5 to 10 lbs. pressure, and the cutter is lifted about ⅛ in. every few seconds so that the emery dust has a chance to work under the teeth of the cutter. As the cutter advances, less pressure is applied. The same cutting agent is used when a drill press is employed to cut the hole, but the wooden guide is dispensed with and a dam of putty is substituted as before to retain the emery compound. A speed of 1500 r.p.m. is recommended for holes up to 1½ in. in diameter, while a slower speed of 800 to 1000 r.p.m. is required for holes of larger size. The teeth of the cutter will dull slightly in use and require touching up occasionally with a file.



GRAFTING

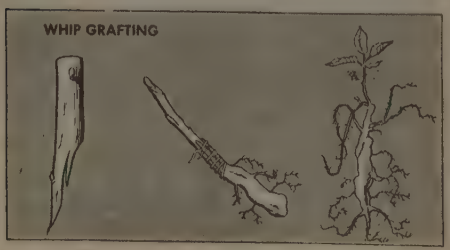
CLEFT GRAFTING



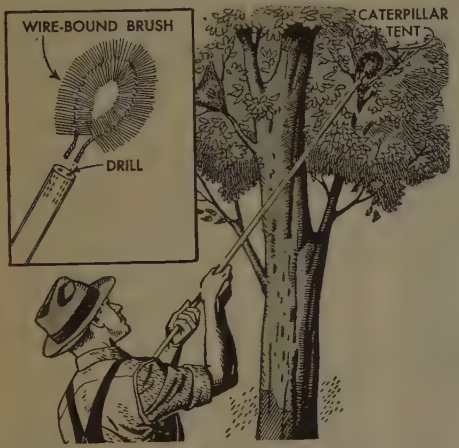
THE SCIENCE OF GRAFTING is complex, and in its fullest application is beyond the interest and the needs of the average home gardener. Few will want to grow seven varieties of apples on one tree, or combine a quince and a pear to produce a dwarf pear tree, or to try to cross grapes and roses. Nevertheless, every gardener should know the general principles of grafting in order that he may keep his trees, shrubs and other woody plants healthy.

All grafting involves the use of *cions*. These are budding twigs or roots which are clipped from live trees or plants and brought into contact, called the *union*, with the inner bark or the roots of another plant, called the *stock*. The union may be made with a tree or plant of the same kind, or a different variety of the same species or genus. Thus, grafting may be used to grow new branches on the side of a tree that has shaped poorly, or on which some of the branches have been damaged. Or, the roots of a hardier variety of shrub may be grafted to those of one which is graceful but rather delicate. The chief methods are *bud grafting*, *cleft grafting, whip grafting* and *inarching*.

Bud grafting is illustrated above. The first need is a good budding knife, which may be purchased, although any sharp knife with a thin blade that ends in a curve will do. Then select the cion—a healthy twig that has grown 12 in. or more during the past season—and cut one of the buds from it. The bud is cut away to include a bit of the bark above and below, and a thin shaving of the wood beneath the bud. Make a T-shaped cut in the stock, or tree onto which the bud is to be grafted. Make the first cut lengthwise of the stem; next a crescent-shaped cross cut at the top of the first cut. Peel the edges of the bark away carefully, just enough to allow the bud to be slipped inside the bark. The cut surface under the bud should fit snugly against the wood of the stock; if not, trim it to fit. Then tie the slit bark above and below the bud with light cotton twine. A wrapping of muslin that has been dipped in melted paraffin or beeswax should then be placed around the bud. The bandage is removed in from 10 days to two weeks. At intervals during the first weeks of active growth, the sprouts that form around the bud should be removed so that they will not restrict growth. In the spring following the grafting, the stock should be cut away just above the union. Slant this cut away from the bud, and the trunk or branch will grow so as to hide the graft within a few years.



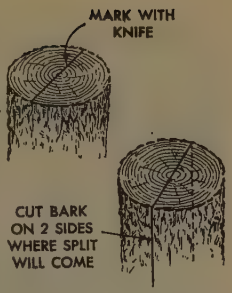
Even when a grafted tree is transplanted properly with the graft above the ground, the top part of the tree will sometimes send out roots. This can be prevented by tying tar paper around the graft. As the tree grows, the wrapping can be allowed to rot away



Instead of endangering fruit or shade trees by burning caterpillar tents with a torch, just pull them off with a long-handled brush and drop them into a can of kerosene. Detail shows how brush can be made

A strong solution of saltpeter will do away with an old stump in the lawn. Bore a series of holes in the top and sides of the stump and fill them with the solution. The wood will soon rot and break up

Cleft grafting often fails because the bark is torn at the point where the tree stock is split to receive the cion. To avoid this, cut cleanly through the bark on both sides with a sharp knife before making the split in the tree center. A split can then be made and the bark will part cleanly without tearing in big patches

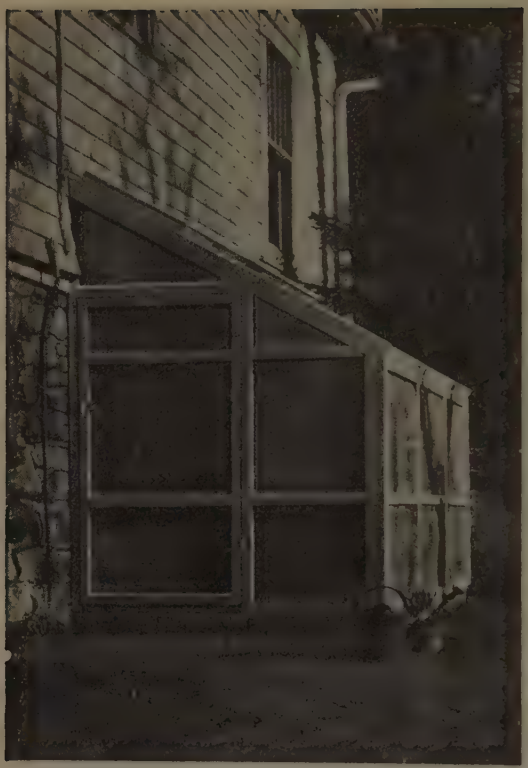


Cleft grafting is usually done when the stock is much larger than the cion. The stock is cut off square at the place where the union is desired. A wedge-shaped cleft is then made in the stub. A grafting tool is available for this, but the cleft can be made satisfactorily with a broad chisel. The cion should be a healthy twig including at least three buds. Cut it so that the lowest bud will be just outside the wedge. Trim the end of the cion to a chisel edge, hold the stock wedge open and insert the cion up to the lower bud. Then let the wedge close and clamp upon the cion. If the stock is large enough, place two cions on either end of the stock to increase the chances of growth. If both cions grow, remove one after the first year. This union need not be bandaged, but must be covered with grafting wax. You can make your own by melting together resin, 2 parts, linseed oil, 2 parts, and beeswax, 1 part. When cool, the mixture should be pulled and worked until it is pliable and light yellow.

Whip grafting is the method used for joining roots. This grafting is done in winter, when the roots are dormant. The joined parts are stored until spring planting. The cion is cut diagonally. Then the cut surface is split to form a thin tongue. The stock is prepared in the same way, and the roots are joined and tied with light twine which has been soaked in grafting wax. The grafts are stored in boxes with moistened sawdust, moss or sand.

Inarching, the simplest graft, is used when the plants grow quite close together. The barks are cut and the plants are bound together at this point. Inarching occurs in nature.

Grafted cions often are damaged or displaced when birds alight on them. This can be avoided by fastening a thin strip of wood to the branch on which the graft is made. The birds will perch on the strip, extending over the cion about 3 in.



Above, this lean-to greenhouse, covered with plastic-sheeted screening is the place to start seedlings for early plantings. Below, there's plenty of room for seed flats and potted plants

You can have cut flowers out of season and start seedlings early by building this walk-in greenhouse against a side of your home

THERE'S no need to clutter up the window sills with seed flats or freeze your fingers breaking out snowbound cold frames in late winter in order to get seedlings started in time for transplanting when warm weather arrives. A lean-to greenhouse is the answer to this perennial problem of gardeners. Moreover, by timing greenhouse plantings you can have cut flowers out of season. The lean-to greenhouse pictured is covered with plastic-sheeted screening and gives you a floor space 5 x 9 ft. Of course, the length of the structure can be increased as much as desired simply by adding studs and rafters on a uniform 3-ft. spacing.

Locate the greenhouse unit on the south side of the house or other suitable building where it will be exposed to late winter and early spring sunlight during the greater part of the day. In severely cold weather, heat can be piped from the furnace or supplied by a small space heater. Use concrete blocks or flat stones for the foundation. Lay the first foundation course of either blocks or stones on a concrete footing below the normal frost line. Half-lap the sills at the outer corners as in Fig. 2 and be sure that the sills are level before setting up corner posts and studding. It will pay to notch, or house, the ends of the braces, or nailing strips, into studs and corner posts as detailed in Fig. 2. This results in a much more durable structure. Because of the high humidity always present in a greenhouse, redwood is the best material for framing. Cypress and white pine are a good second choice.

As the construction of the frame proceeds, plumb all vertical members and check corners for squareness. Note that the eave strip is beveled on the lower edge so that it will fit flush against the outside edge of the plate. The weather stripping over which the ventila-

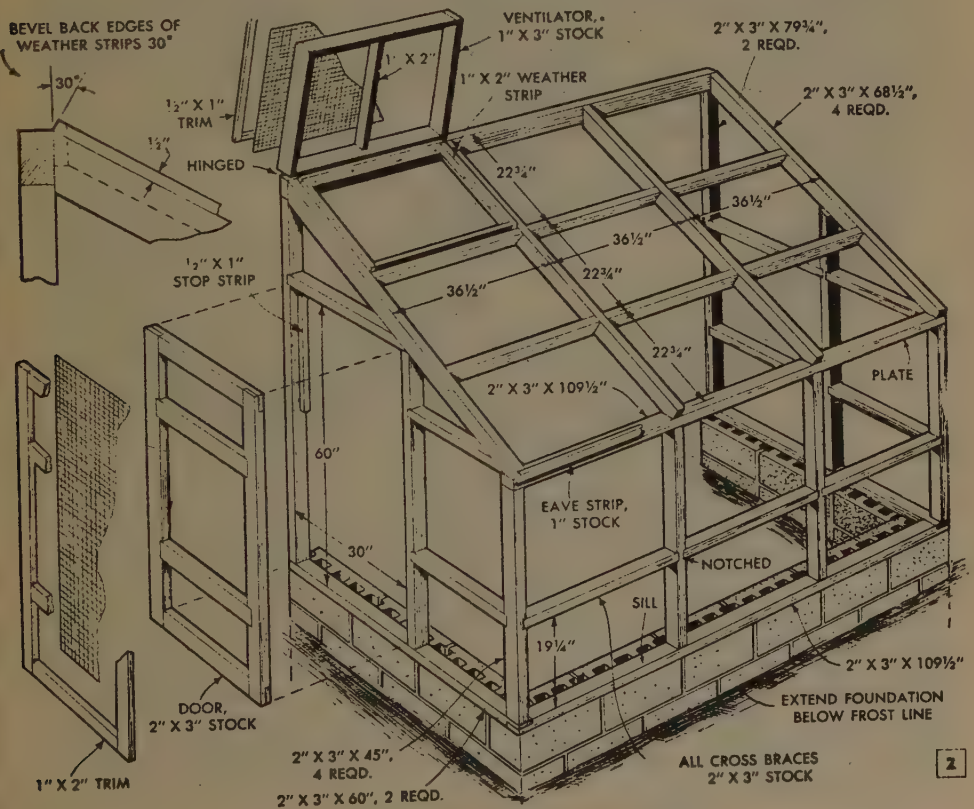
GREENHOUSE

tors fit is beveled slightly on the outside edges to permit the ventilator frames to close without binding. Set the weather strip in nonhardening mastic before nailing to the rafters. The doorframe is made up as detailed with half-lapped corner joints and housed center cross members. Use screws in assembling the joints of both the door and ventilator frames.

After hinging the door and ventilator frames in place the job is ready for the plastic-sheeted covering. Apply mastic to all surfaces which the covering will join, then tack it in place with screen staples spaced about 3 in. apart. Then apply a second coat of mastic over the joints as in Fig. 1 and nail trim strips over all joints. That finishes the job except, perhaps, for a line of calking run in at the joint where the structure joins the house foundation and across the roof joint back of the ventilators. Paint all interior woodwork with two coats.

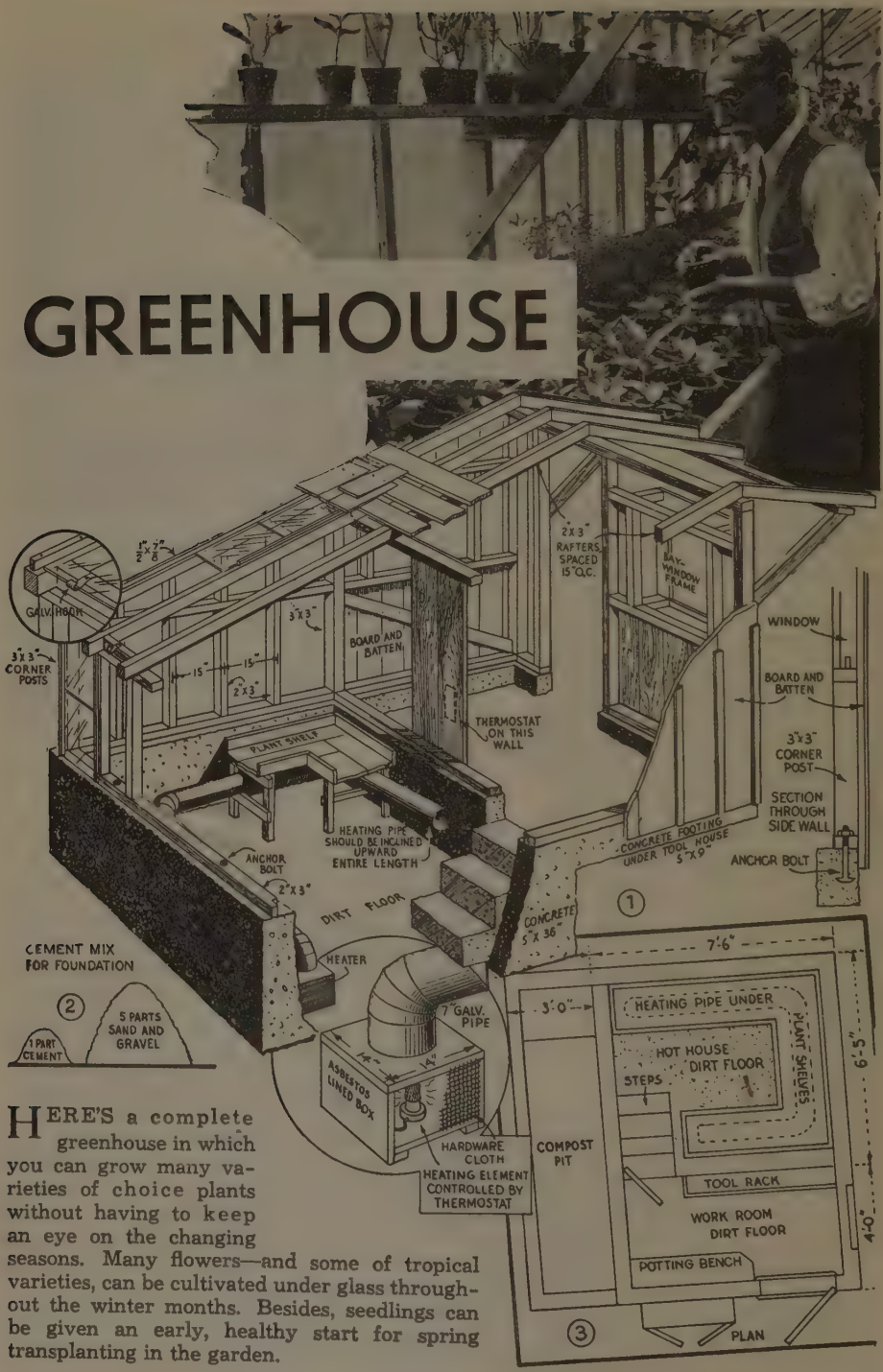
[Design and photos courtesy Celanese Corp. of America]

Mastic applied under and over plastic-covering joints makes tight, waterproof job on walls and roof

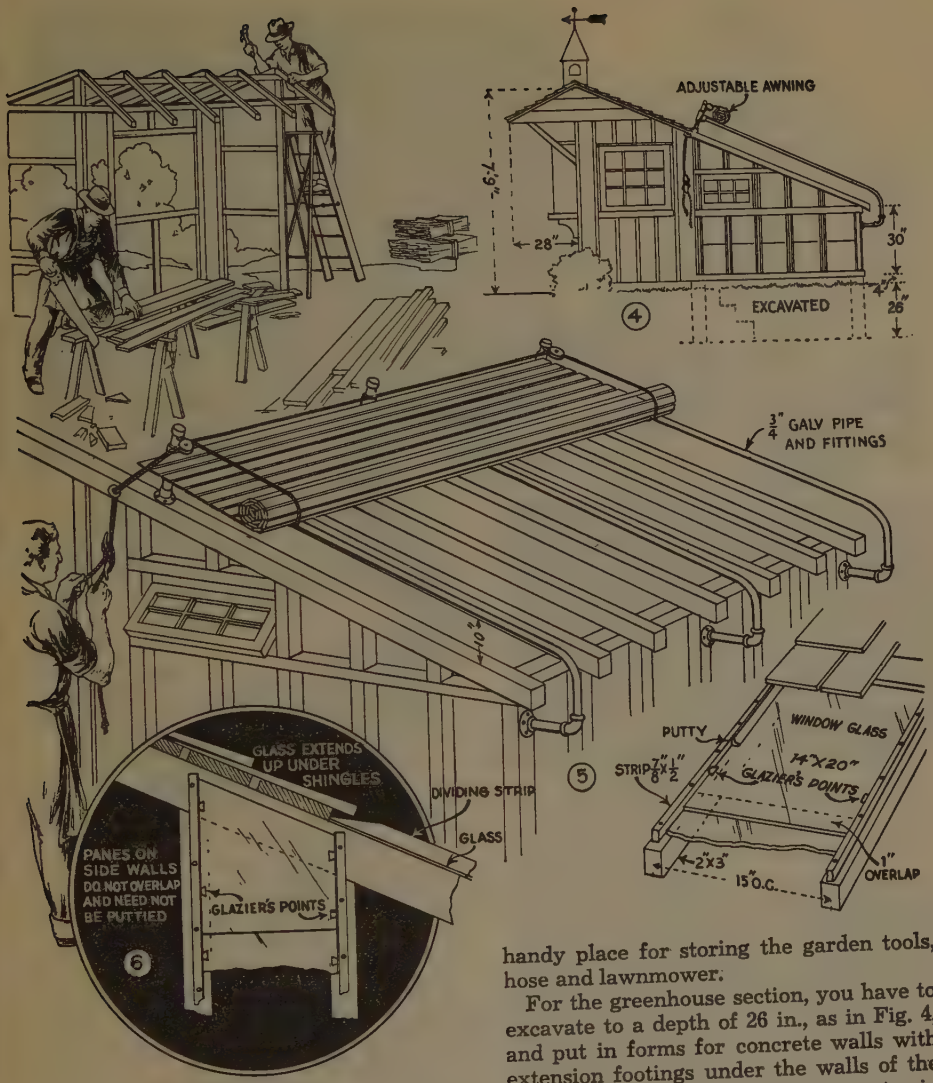


2

GREENHOUSE

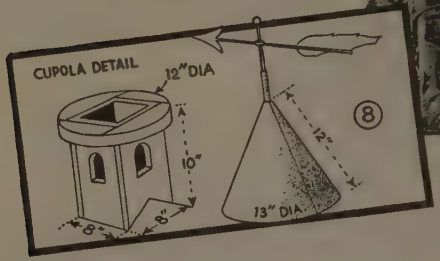


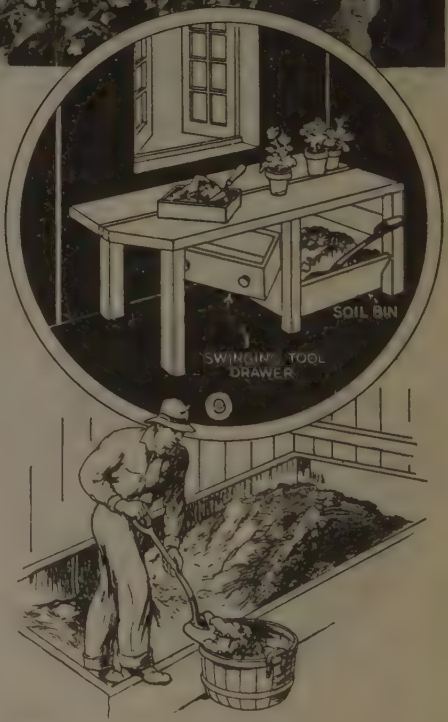
HERE'S a complete greenhouse in which you can grow many varieties of choice plants without having to keep an eye on the changing seasons. Many flowers—and some of tropical varieties, can be cultivated under glass throughout the winter months. Besides, seedlings can be given an early, healthy start for spring transplanting in the garden.



The continuous, sloping roof will save you a lot of trouble in building as a single set of rafters supports both the shingled and the glazed sections. From Figs. 1 and 3 you'll gather the general details and sizes of materials. The floor plan is merely a suggestion for the minimum size. You can increase this considerably and still use the same size materials for framing. A workroom with ground-level floor gives room for a potting bench, Fig. 9, while a rack built along the inside wall makes a handy place for storing the garden tools, hose and lawnmower.

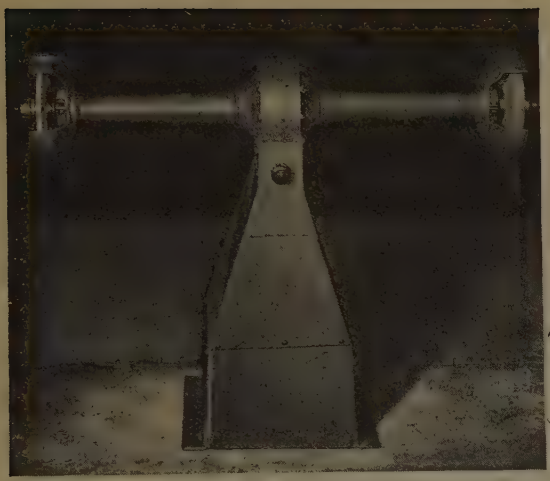
For the greenhouse section, you have to excavate to a depth of 26 in., as in Fig. 4, and put in forms for concrete walls with extension footings under the walls of the workroom as in Fig. 1. The cement mix for both walls and footings is shown in Fig. 2. The sills are fastened to the concrete with anchor bolts spaced about 16 in. apart. If there's room along the lot line it's a good idea to include the compost pit, in Fig. 3. If you do this, the foundation wall of the greenhouse is continued to the front, the excavation for the pit being the same depth as that for the greenhouse and walled with concrete on the remaining three sides. The rear end of the pit should



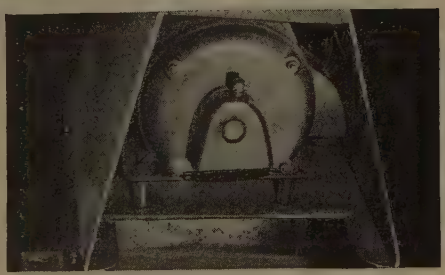


slope for easy removal of the contents. Grass and plant clippings mixed with moderate quantities of wood ashes and soil, will decompose in the pit and form an excellent fertilizing humus for your growing plants.

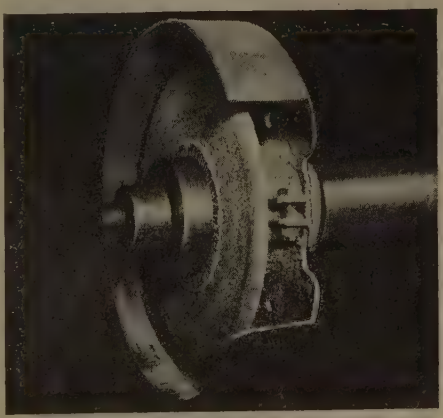
When you get the studding up and the rafters in place as in Fig. 1, you first board up the side walls of the workroom, put on the roof boards and lay the shingles. Then the glazed portion of the roof goes on. First, a ½ by ⅞-in. strip is nailed along the center line of each rafter, after which the panes of double-strength window glass are set between the strips, with the ends overlapping 1 in., and are fastened with glaziers' points and putty as in Fig. 5. Note that the upper ends of the roof panes extend up under the shingles as in Fig. 6. On the side walls the ends of the panes butt together, glaziers' points and narrow strips being tacked in the corners to hold the glass in place. A small tilting window frame can be installed in each end of the greenhouse as in Fig. 5. A door to the workroom, front casement windows and a cupola, made as in Figs. 7 and 8, complete the exterior details of the building. An awning over the glazed roof, as in Fig. 5, helps to protect delicate plants from the direct rays of the summer sun and aids in maintaining a uniform temperature. Such an awning can be made from a porch shade, galvanized pipe and pulleys at a moderate cost. Inside, you install plant shelves to suit your requirements, and an electric heater controlled by a thermostat as in Fig. 1. The exterior of the building is primed and then given two coats of outside white paint. Or, if you prefer, the surface of the wood may be stained with a gray or green shingle stain.



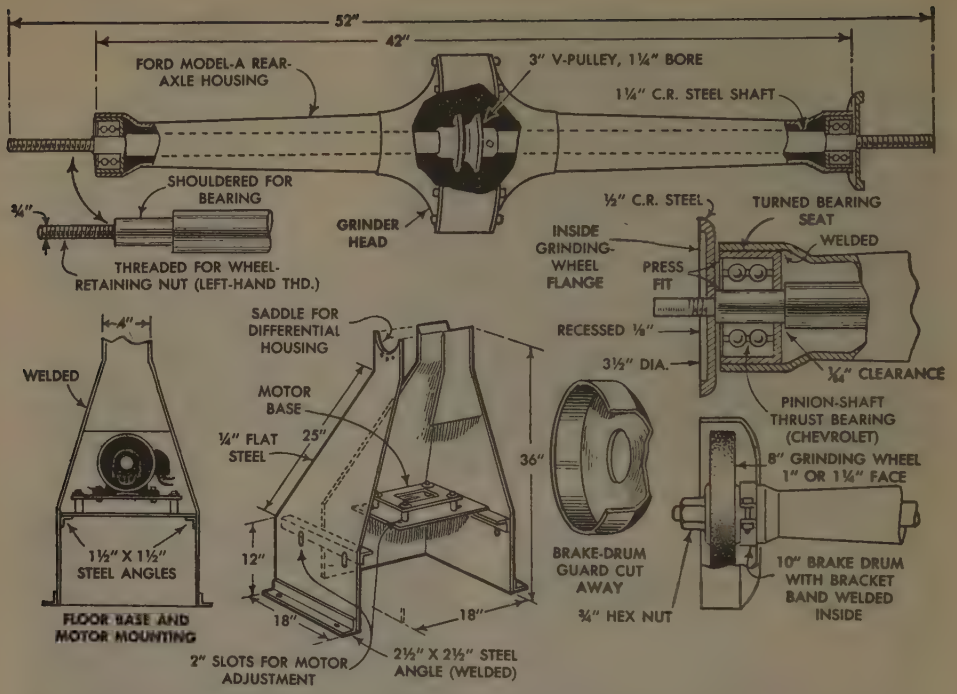
GRINDER



Above, motor is mounted inside pedestal on adjustable base and drives with half-crossed V-belt. Below, wheel guards are made from discarded brake drums fitted with bolt brackets which clamp to housing



ALTHOUGH this grinder was built and proved in a farm workshop, it has a much wider application due to the exceptionally long shaft housings which permit heavy grinding and polishing operations on a variety of large work. Plating shops will find it particularly useful for polishing plated work where large cloth buffs are used. In the farm shop it handles any grinding job that can be done on an 8-in. wheel. As you will see from the photo above, the machine is floor-mounted on a heavy pedestal made from welded steel plates. The motor is housed within the pedestal and drives with a half-crossed V-belt as in the center photo at the right. The grinding spindle is mounted in a Ford model-A rear-axle housing and runs on ball bearings. It is 52 in. long, double shouldered at each end from 1¼-in. diameter to ¾ in. in diameter in two steps. The intermediate step at each end of the spindle is ground to a press fit in a pinion thrust bearing taken from a Chevrolet rear axle. The small ends of the spindle are threaded right and left hand for the grinding-wheel flanges and retaining nuts. Flanges are machined from ⅜ or ½-in. flat steel. One corner is broken (rounded over),

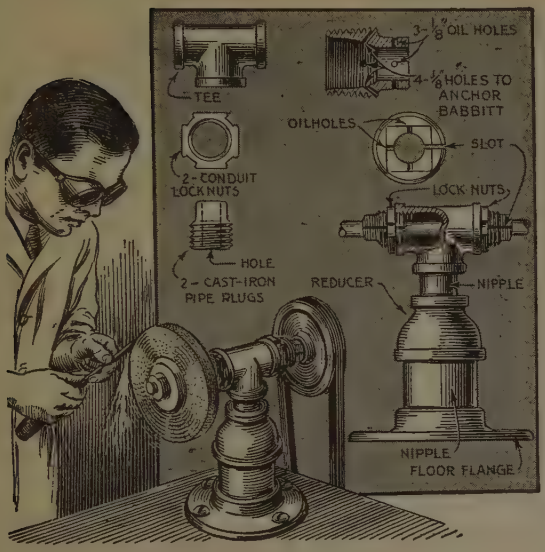


As detailed above, grinder pedestal is made from ¼-in. steel plates cut and welded to form a tapering column. Long spindle makes this unit especially useful for grinding and buffing operations on large, irregular work

and the inner face of each flange is recessed ⅛ in. as shown in the sectional drawing above at the right.

When assembling, place both the V-pulley and belt on the shaft as it is inserted in the housing. After the shaft has been positioned and the bearings have been pressed in place, the pulley can be properly located on the shaft and the setscrew tightened by reaching in through the drive-shaft opening. Only general dimensions are given on the pedestal-type base in the detail above, as some adaptation is necessary because of varying sizes of motor frames. Note that the ¼-in. steel side plates are bent inward at a point 12 in. above the lower ends and that the edges are cut at an angle to give a width of approximately 4 in. at the top ends. The top ends of the side pieces are cut on a radius approximately the same as that of the differential-gear housing, and holes are drilled through the side pieces on the same spacing as those in the bell ends of the axle housing. In this way, the Ford model-A axle, which becomes the grinder spindle assembly, can be bolted to the top ends of the base pieces simply by removing six of the original cap screws and inserting longer ones. The front piece of the base is a duplicate of the side pieces except that it is not cut on a radius at the top end. However, the back piece is only a short plate which serves as a filler, leaving the back of the base open for placement of the motor base and motor. All joints in the base are welded. Steel angles, which support the motor base, are bolted to the sides of the floor base as detailed. Note that the holes are slotted to allow for vertical adjustment of the motor when tightening or loosening the belt. When installing the motor, be sure that the pulleys are correctly aligned so that the half-crossed belt will run freely and without undue friction on the sidewalls of the V-pulleys. Use a 3½-in.-dia. pulley on a 1725-r.p.m. motor to give the correct grinding-wheel speed for heavy work. Higher speeds may cause the long wheel spindle to whip, with resulting danger of wheel breakage. Wheel guards are made from 10-in. automobile brake drums by cutting away a section of the drum to expose the face of the wheel as in the lower right-hand photo on the preceding page. The drums are attached to the spindle housing with bracket bands made from flat steel and welded to the inside of the drum. Mounted in this way, the wheel guards are quickly removed for buffing operations.

Grinder Head Made From Pipe Fittings

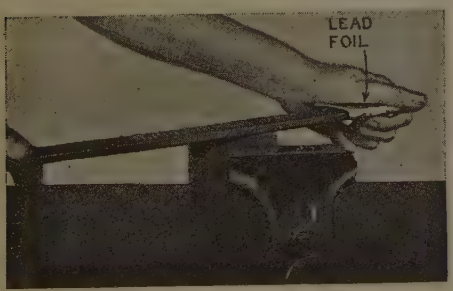


A few standard pipe fittings can be assembled to make an inexpensive grinder head. Any size fittings that complement the workbench can be used. After the base is assembled, the bearings made from pipe plugs are screwed into a tee at the top of the base. A ½-in. hole is drilled through each plug to take the spindle. Then, located around the plug, four ⅛-in. holes are drilled for anchoring the babbitt. Also, oilholes are drilled through the walls at the end of the plug. This may be done after pouring the babbitt; or, if the holes are drilled previously, the babbitt can be pierced later. The plugs then are slotted lengthwise along one side to allow for bearing take-up and secured in place with conduit lock nuts. These may have to be retapped to fit the plug without damaging the threads.

GRIPPING HANDLES

Foil Grip on End of Rasp or File Protects Your Hand

Wrapped tightly around the end of a file or wood rasp, a strip of lead foil serves as a comfortable hand grip when using the tool for long periods of time. It is unnecessary to tie or wire the foil in place as the soft metal presses firmly into the file teeth, which hold it in place when the grip of your hand is released.

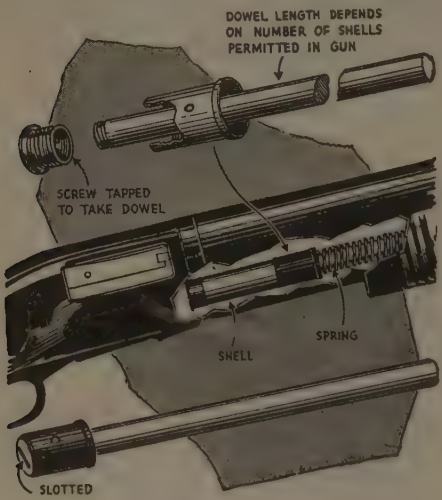


Re-Knurling Handlebar Grips

When the knurling on the facings of motorcycle or bicycle rubber handlebar grips becomes worn so that the hands slip, the grips can be re-knurled with a hack-saw blade. Cuts are made in the rubber spirally around the grip in first one direction and then the other, as indicated.

Gun Plug in Cartridge Magazine Is Easy to Insert and Remove

If you do considerable hunting with a shotgun in localities where the use of a plug is prescribed by law to limit the number of shells carried in the gun, you'll find a plug like the one shown easy to insert and remove. It is inserted from the cartridge-loading end instead of the usual way of inserting a plug from the muzzle end of the magazine. Instead of a plain length of dowel, the closed end of the cartridge carrier inside the magazine is bored out and fitted with a brass cap. This is threaded to screw inside a brass sleeve, which is a drive fit inside the cartridge carrier. The cap is bored and threaded so that the plug can be screwed into it. Then the



cartridge carrier with its brass cap is replaced in the magazine. Now, when it is necessary to use the plug, "break" the gun, remove the brass cap, insert the plug and reassemble. In this way, the plug cannot slide back and forth inside the magazine when the latter contains less than three shells.

GUN CABINET

MATERIAL YOU WILL NEED

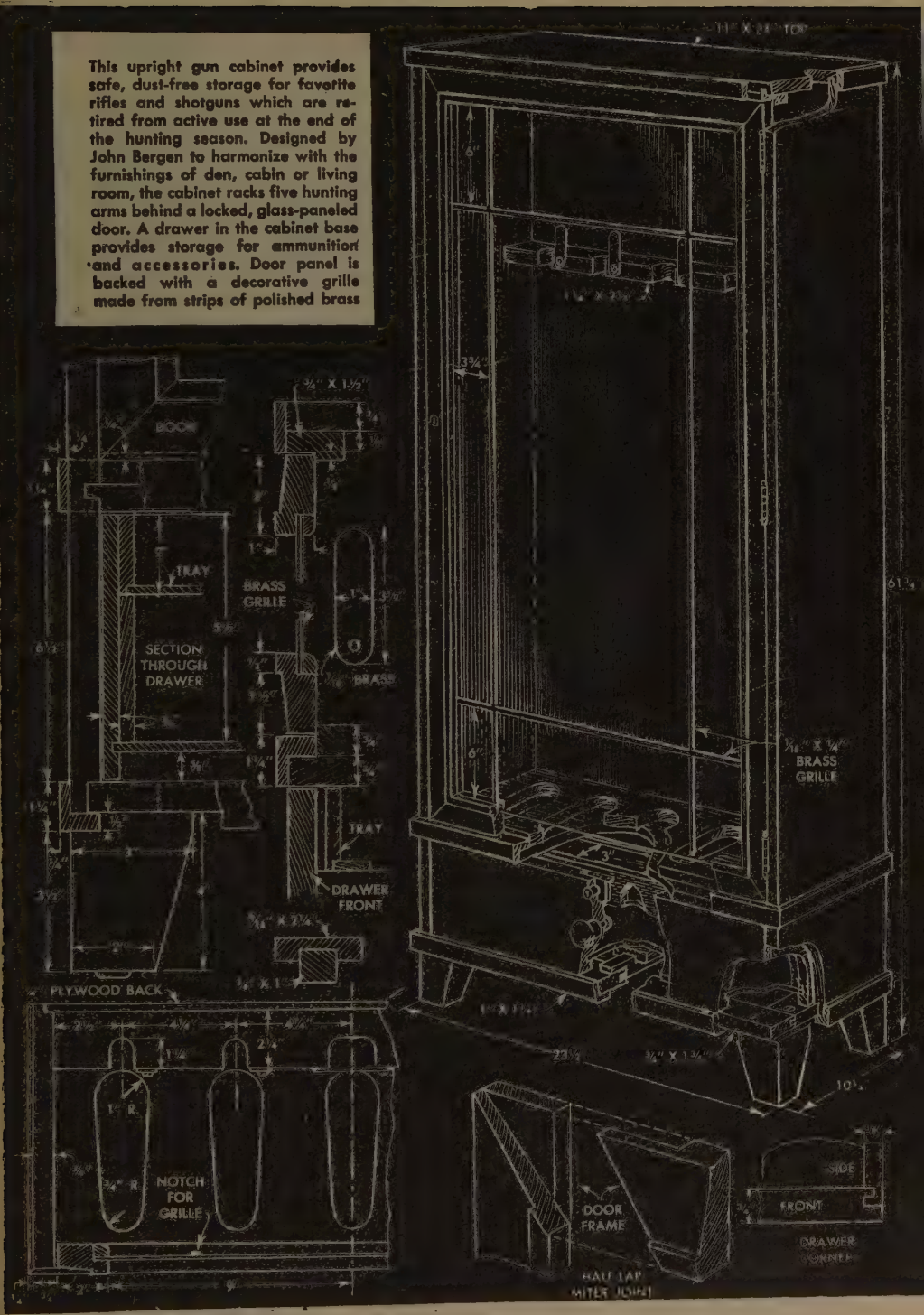
Plywood
1 pc.—¼" x 22¾" 57⅜"—Back
1 pc.—½" x 8⅜" x 21¼"—Drawer bottom
1 pc.—¼" x 3⅜" x 20¼"—Tray bottom

Cabinet Wood
2 pcs.—¾" x 9¾" x 57⅜"—Sides
1 pc.—¾" x 10¾" x 23½"—Top
1 pc.—¾" x 10½" x 22¾"—Shelf
1 pc.—¾" x 9¾" x 22"—False shelf
1 pc.—¾" x 6½" x 22"—Drawer front
2 pcs.—1" x 2" x 48"—Side doorframe
2 pcs.—1" x 2" x 22"—Top and bottom frame
1 pc.—1¼" x 2½" x 22"—Rest rail
4 pcs.—¼" x 1¼" x 10"—Side overlay
1 pc.—¼" x 1¼" x 24"—Front top overlay
2 pcs.—1" x 1¼" x 24"—Front-rail facing
2 pcs.—1" x 1¼" x 10"—Bottom facing
4 pcs.—3" x 3" x 4"—Legs
2 pcs.—⅜" x ½" x 47⅛"—Glass molding
2 pcs.—⅜" x ½" x 18⅛"—Glass molding

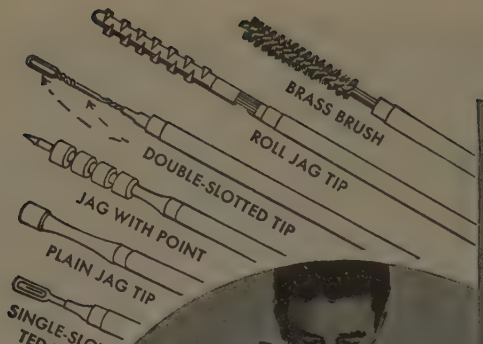
Lumber
2 pcs.—⅜" x 6½" x 9"—Drawer sides
1 pc.—⅜" x 6¼" x 21¼"—Drawer back
2 pcs.—⅜" x 3½" x 8"—Tray rails
2 pcs.—¾" x 3¾" x 2"—Tray ends
2 pcs.—⅜" x 2" x 20⅜"—Tray sides
2 pcs.—¾" x 1¾" x 22¾"—Front and back drawer rails
2 pcs.—¾" x 1¾" x 7"—Side drawer rails
1 pc.—¾" x 1" x 8⅜"—Drawer guide
1 pc.—9/16" x 2¼" x 8⅜"—Drawer slide

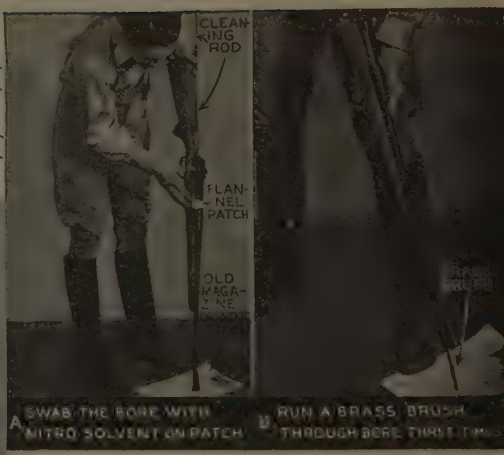
Miscellaneous
3—butt hinges, 1½" x 1½"
2—locks
1—2" dia. brass knob
2 pcs. brass, 1/16" x ¼" x 44⅞"
2 pcs. brass, 1/16" x ¼" x 18⅞"
5 pcs. brass, 1/16" x 1" x 3½"
1 pc. double-strength glass, 18⅛" x 44⅞"
4—⅝" dia. glides

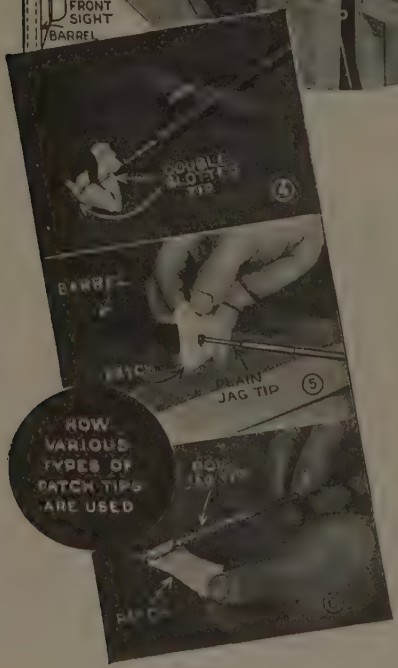
This upright gun cabinet provides safe, dust-free storage for favorite rifles and shotguns which are retired from active use at the end of the hunting season. Designed by John Bergen to harmonize with the furnishings of den, cabin or living room, the cabinet racks five hunting arms behind a locked, glass-paneled door. A drawer in the cabinet base provides storage for ammunition and accessories. Door panel is backed with a decorative grille made from strips of polished brass



GUN



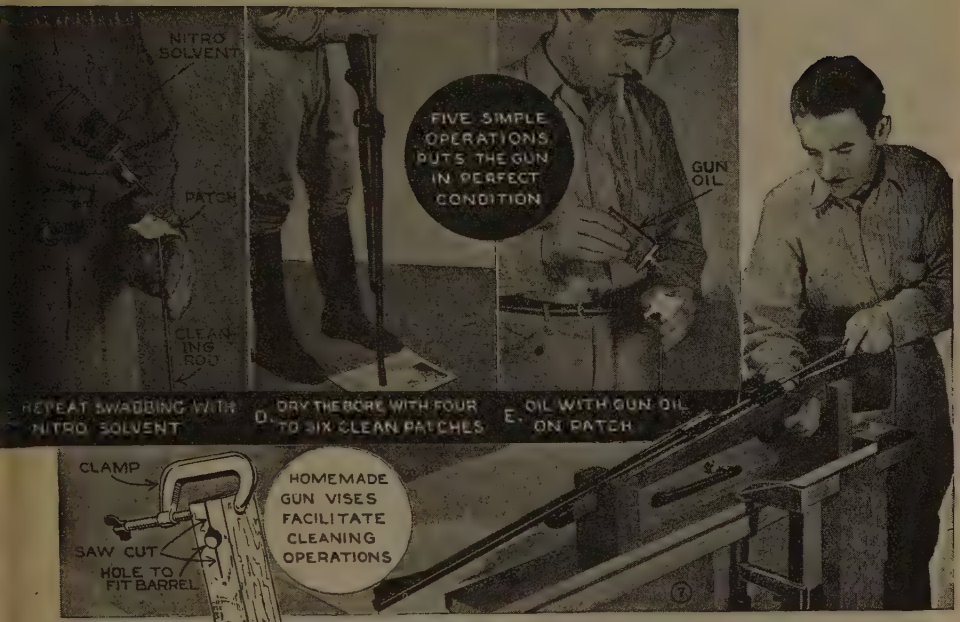

CLEANING ROD
FLANNEL PATCH
OLD MAGAZINE
A SWAB THE BORE WITH NITRO SOLVENT ON PATCH
B RUN A BRASS BRUSH THROUGH BORE THREE TIMES



INCREASED accuracy, smoother shooting and longer gun life will reward the shooter who spends a little time in keeping his guns in first-class condition. Given a new gun to start with, a few minutes' cleaning time will keep it in perfect condition whereas the neglected gun becomes increasingly difficult to clean satisfactorily.

Cleaning a rifle or shotgun involves five simple operations, as shown by the photos A to E inclusive. The bore is first swabbed with a flannel patch well saturated with nitro solvent. Cleaning should be done from the breech of the barrel if possible, and the muzzle of the gun should rest on a clean magazine or a block of wood. The patch should be run up and down the bore several times to saturate the powder residue thoroughly with the solvent oil. Any brand of powder solvent available at a hardware store will do. Operation No. 2 calls for a brass brush. Running this up and down the bore will remove the sticky powder fouling partially loosened by the action of the solvent. The brush should be pushed out of the barrel on each down stroke. Reversing the direction of the brush inside the bore does nothing but ruin the brush. Next repeat the first operation. The object of the fourth operation is to dry the barrel thoroughly. Start by wiping the rod clean. You will need four to six clean patches. Run the first patch down, up, down and out at the muzzle end. Run the rest of the patches through the bore once only, discarding each at the muzzle end. The final patch should

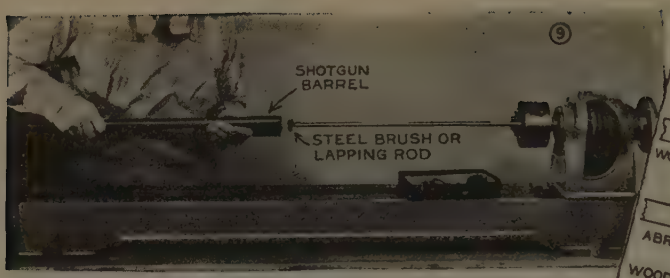
CLEANING

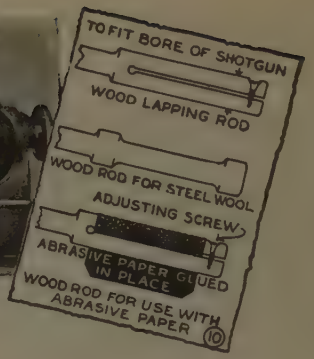

NITRO SOLVENT
PATCH
CLEAN ING ROD
FIVE SIMPLE OPERATIONS PUTS THE GUN IN PERFECT CONDITION
GUN OIL
REPEAT SWABBING WITH NITRO SOLVENT
D. DRY THE BORE WITH FOUR TO SIX CLEAN PATCHES
E. OIL WITH GUN OIL ON PATCH
CLAMP
SAW CUT
HOLE TO FIT BARREL
HOMEMADE GUN VISES FACILITATE CLEANING OPERATIONS
7

show perfectly clean and dry. If it shows dirt, the preceding operations must be repeated. The final operation is oiling. This is done with a clean patch. Use any good gun oil. This will protect the gun for a period of four to eight weeks. If the gun is to be stored for a longer period than this, use gun grease instead of the lighter oil.

As previously mentioned, cleaning should be done from the breech. Cleaning the gun from the muzzle permits the rod to rub at this vital point, causing wear which may influence the accuracy of the weapon. Some guns cannot be cleaned from the breech. In this case it is advisable to use a wooden or brass muzzle cap, Figs. 2 and 3, to protect the muzzle. If you use a plain jag tip for cleaning, the chamber should be fitted with a cartridge case plugged with wood. This will prevent the patch from working loose as it sometimes does when pushed into the larger diameter of the chamber.

Fig. 1 shows the five types of cleaning tips commonly used. The single slotted tip is the simplest. It has the advantage of holding onto the patch under all conditions, but has two disadvantages in that the patch sometimes jams when reversed inside the bore, and, the cleaning action is often one-sided, permitting the bare sides of the tip to rub the bore. The plain jag tip gives a uniform cleaning action, and reverses perfectly inside the barrel. The patch sticks to the tip as long as it is inside the barrel, but any chance movement beyond the muzzle or chamber will cause




TO FIT BORE OF SHOTGUN
WOOD LAPPING ROD
WOOD ROD FOR STEEL WOOL
ADJUSTING SCREW
ABRASIVE PAPER GLUED IN PLACE
WOOD ROD FOR USE WITH ABRASIVE PAPER
⑩

METAL-FOULING SOLUTION

Ammonium Persulfate	1 oz.
Ammonium Carbonate	200 gr.
Water	4 oz.
Stronger Ammonia	6 oz.

Powder the first two ingredients together and dissolve in water. Add the ammonia. Keep the solution in a large bottle having a rubber cork

it to come loose. The same applies to the jag tip with point. The point is an advantage in centering the patch previous to insertion in the bore. The double-slotted tip is a first-rate cleaner, with a uniform action. The roll jag permits rolled or wrapped patches, and is preferred by many shooters on this account. The patch is wrapped around the jag as shown in Fig. 6, and can be made tight or loose as desired. Fig. 5 shows how the plain jag is used, the patch simply being centered on the tip, while Fig. 4 shows the obvious way of using either the single or double-slotted tip.

The cleaning rod itself can be brass or steel and should be of a proper diameter to fit the bore of the rifle. It must be fitted with a swivel joint so that the patch will rotate inside the bore, following the rotation of the rifling. Without this rotation, the patch will drag at right angles across the lands and will quickly destroy the sharp edges of the rifling. The patch should be of such a size as to require three or four pounds' pressure to force it through the bore of the rifle. A shotgun cleaning rod does not require a swivel joint, as this weapon has a smooth bore. Other than this variation, the cleaning technique is exactly the same, with the exception that most shooters prefer a wire-gauze cleaner or a brass worm instead of a brass brush.

The cleaning operation as described can be simplified greatly if some type of vise is made to hold the gun. Rifles are easily held in a simple jig consisting of two wooden chocks nailed to a baseboard, Fig. 7. Shotguns can be clamped in the jig shown in Fig. 8. Clamping in a standard wood vise is also satisfactory, but care should be taken not to exert too much clamping pressure.

Other than powder fouling, the shooter must sometimes give consideration to metal fouling. This is a deposit of metal left by the bullet in the bore. If you shoot lead bullets, the fouling is more specifically designated as "leading." It is obvious that a perfectly smooth, polished bore will pick up very little metal fouling, whereas the roughened, neglected bore will always foul to a greater extent. Metal fouling in itself does no particular harm to the bore, but it may trap powder residue beneath it, leading to corrosion of the bore. Metal fouling can be detected by a careful examination of the bore, in which the fouling will show as long streaks, flaky deposits or even ac-

tual lumps of metal sticking to the lands and grooves. The fouling is easily removed, if attended to promptly, by using the metal-fouling solution specified in Fig. 11. The liquid is kept in a tightly corked bottle at all times except when actually using the solution, since it loses strength quickly when exposed to air. This can be applied with a cloth patch in the usual manner if the deposit is light. For a more thorough action, the solution is poured into the bore of the gun after first plugging the chamber with a rubber cork. When first poured in, the solution will be as colorless as water but will asume a deep blue color as it begins to dissolve the metallic deposit. The action is complete in about 15 min. Care should be taken in using the metal-fouling solution as it will remove bluing or the finish on the stock. After the solution has been removed from the barrel, the regular cleaning procedure should follow immediately.

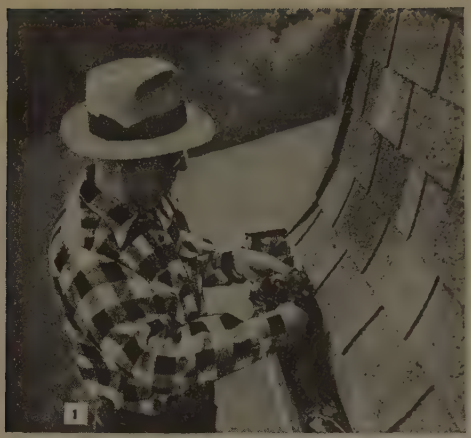
Leading can be removed with the metal-fouling solution. Many shooters, however, prefer mercury. A few ounces of this are placed in the barrel. A finger over the muzzle will hold it inside, and a few tips up and down will cause the mercury to amalgamate with the lead deposit. The solution can be used many times. Mercurial ointment is a satisfactory remedy for leading as is also common vinegar or a dilute solution of glacial acetic acid.

Metal fouling in shotgun barrels or any condition of rusting or pitting can be removed usually by mechanical methods as the smoooth bore permits almost any type of polishing. The cleaning operation is most conveniently done in a lathe, mounting the polishing barrel or abrasive in the lathe and holding the gun barrel in the hands, as shown in Fig. 9. Steel brushes and polishing heads for this purpose can be purchased, or the shooter can make his own, as in Fig. 10, to be used with paste abrasive, steel wool or abrasive paper.

GUN RACK

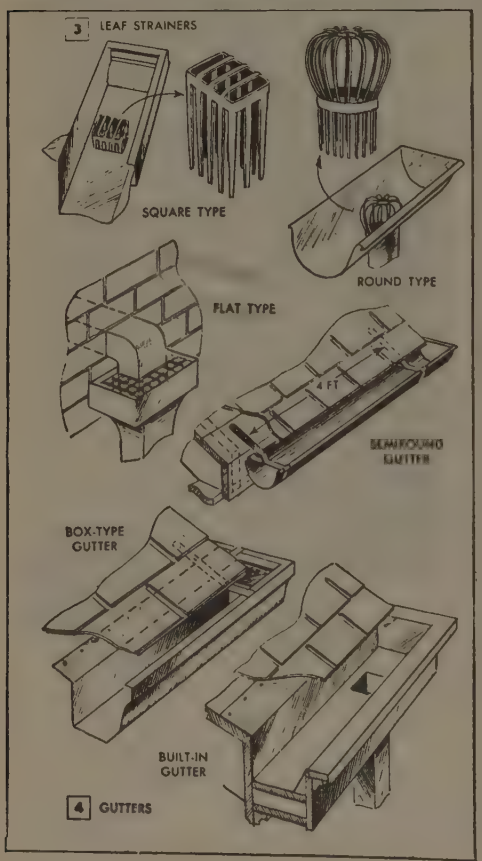
This Gun Rack Hangs in a Corner Where It Takes Little Space

Different from the usual gun rack in that it can be hung in a corner above the floor to make cleaning under it easy, this rack consists of a standard carrying a shelf at the bottom for the gun stocks and a notched holder at the top to receive the barrels. The shelf is cut on a 14-in. radius and is screwed and glued to the lower end of the standard. Metal braces add further support to the shelf. The notched holder at the top is screwed to the standard, which is chamfered at the edges. A ring at the top for hanging the rack engages a hook in the wall. If desired, small holes can be drilled in the notched holder to take cleaning rods.



Clean gutters thoroughly after leaves have fallen, as they cause stoppages. After leaves and debris are removed, flush gutters with a hose and then check for leaks and drainage pitch

GUTTER REPAIR



IT'S EASY to put off inspecting and cleaning the gutters and downspouts on your home from year to year until they finally deteriorate to a point where they are beyond repair and must be completely replaced. Yet, it is possible to lengthen the serviceable life of these important fittings from five to ten years by thoroughly cleaning them and making minor repairs on a yearly schedule that any homeowner can carry out himself. Leaky, damaged and partially clogged gutters not only give unsatisfactory service, but they also can be the indirect cause of other, more serious, troubles, such as water getting into the attic or seeping into brick walls, causing unsightly efflorescent stains, Fig. 5, and a gradual deterioration of the brickwork near the cornices. For these reasons, regular servicing of the gutters is a sure way of reducing home-upkeep costs.

Keep gutters clean: Immediately after the leaves come down in the fall is the time to get busy and clean out gutters and downspouts to avoid stoppage resulting from accumulations of leaves and dirt. Even if leaf guards or strainers have been installed at the downspout openings, an accumulation of wet leaves will prevent proper drainage and may cause water to overflow and seep into the walls of the house. Rotting leaves combine with cinders and soot to form an acid that hastens rusting of the sheet-metal gutters. For these reasons, it is essential to remove the leaves, and other debris, as soon as possible after they col-

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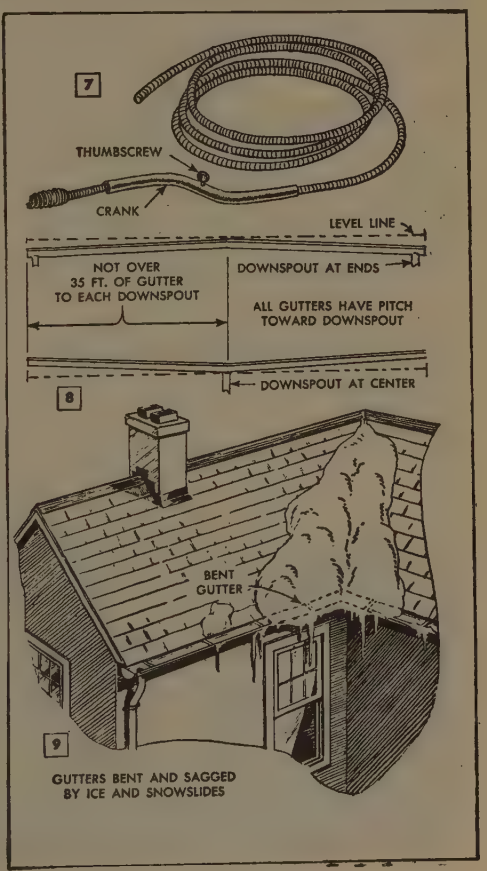
Photo 5 shows efflorescent stains on brick wall subjected to water seepage from roof or gutter. Loosen tight stoppages in downspout by using sink-drain auger, then flush with a hose

AND MAINTENANCE

lect, Fig. 1, and then flush the gutters with a hose, Fig. 2. While flushing, inspect both gutters and downspouts for leaks and repair them immediately.

Clearing stopped downspout: If the gutters are not fitted with leaf strainers, Fig. 3, leaves may accumulate in the leaders, Fig. 16, and completely close the passage. In cold weather, water may collect and freeze in clogged elbows and downspouts. Although these parts are corrugated for the purpose of preventing damage from freezing, a large amount of water freezing solidly behind a leaf dam may expand the metal sufficiently to force open the rolled joint. An auger of the type used for clearing obstructions in sink drains, Figs. 6 and 7, can be used to loosen tightly packed leaves in either the leader or downspout. After the mass has been loosened, insert the hose in the leader with the water turned on at full pressure. Sometimes full pressure from the hose alone will do the trick. Where the downspout connects directly to the storm sewer, masses of wet leaves and dirt may collect at the bend below grade. To clear this, remove the downspout and insert a drain auger at the joint where the lower end of the downspout enters the bell tile above grade. Then flush with a hose.

Down pitch of gutters: To drain properly pitch gutters down slightly toward the drop outlet at the end as in Fig. 8. Especially long runs may be fitted with a drop outlet at both ends, or one in the center as shown. Each downspout will handle about 30 to 35 ft. of gutter

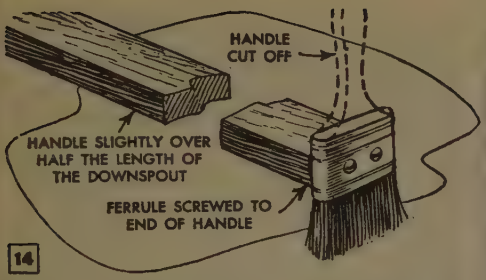


Sheet-metal gutters of all types should be protected with asphalt-base corrosion preventives. After gutters are thoroughly cleaned, material is applied with brush

length. On some types of homes a noticeable pitch of the gutters detracts from architectural lines and in this case the gutters are installed horizontal, or level. This also is true of attached wooden gutters which usually are installed in this manner. Gutters installed level must not be permitted to sag, as otherwise some water will be left standing to evaporate after each summer shower. This accelerates rusting and provides an ideal breeding spot for mosquitoes. If metal gutters become bent or sagged in places, the cause is usually ice or snowslides from a high, steep roof, Fig. 9. As a rule, the gutter is quite easily straightened if none of the hangers has been pulled loose. In case some hangers have been loosened, it will be necessary to renail or replace them, as the gutter will sag permanently without their support.

Rust prevention: Gutters and downspouts of nonrusting metals, such as copper and aluminum, have been widely used in both new and old construction, but the semi-round and box types of galvanized sheet metal are perhaps the most common. When the galvanized coating is impaired, rust attacks the bare metal and eventually eats through, causing leaks. Sometimes soldered joints pull loose, either because of stresses caused by expansion of freezing water, or because of an inadequately soldered joint. For the same reasons, slip-joint connectors sometimes open and, generally, they should be replaced. Effective rust protection for the inside surfaces of gutters and downspouts is attained by applying a heavy coating of elastic roofing cement, smokestack paint or the asphalt-base compounds used on the underside of autos as a corrosion preventive. Any of these materials will adhere tightly to clean metal and, after drying, they are sufficiently flexible to expand and contract with the metal, thus providing an unbroken protective film. This film, in most cases, also resists acids which form when wet leaves and soot are combined. Asphalt-base coatings should be used only on the inside of the gutter, as they tend to bleed through oil paints applied to the outside of the gutters. The coating is simply brushed onto the bare, clean metal, Fig. 10, after rust and loose dirt have been removed. Small breaks in the metal generally can be stopped with ordinary roofing cement, but large breaks will require a fabric retainer. First, coat the surrounding surface with cement, as in Fig. 11, and then press a piece of muslin or light canvas against the wet surface, Fig. 12. Finally, another coat of cement is applied over the fabric as in Fig. 13. To coat the inside of a downspout, alter an old paintbrush by cutting off the handle and

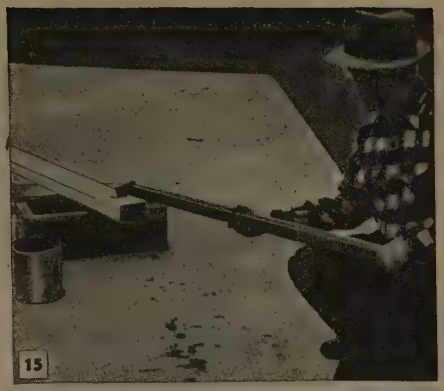
Small breaks in the metal can be closed by a fabric patch. First, apply compound with a brush as in Fig. 11, then press the canvas patch in place as in Fig. 12. Apply final coat over the fabric, including edges



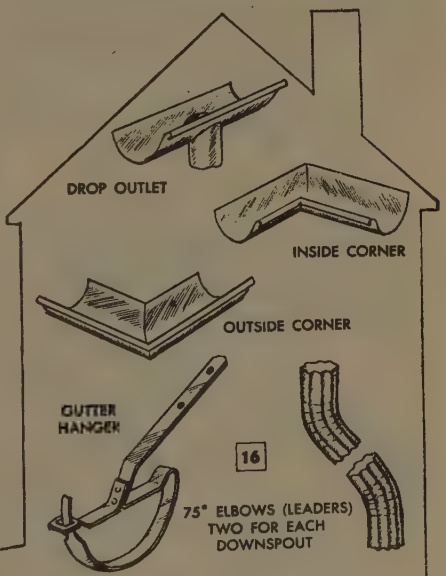
screwing the ferrule to one end of a long strip of wood which serves as a handle, Figs. 14 and 15.

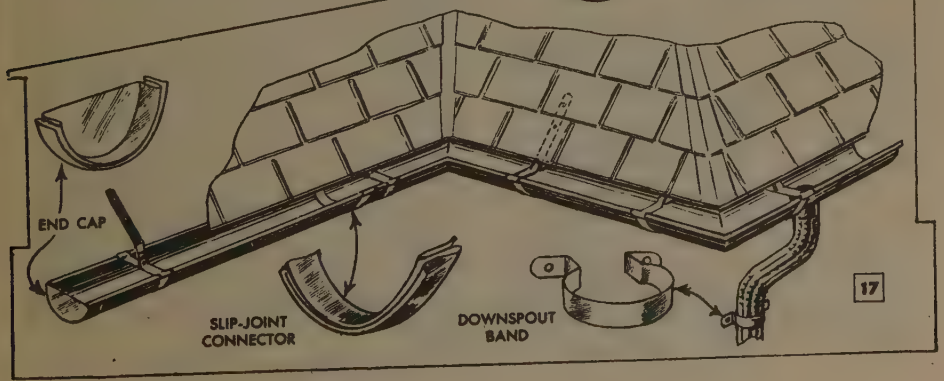
Replacing gutters: Gutter and downspout units and accessories of the semiround type are detailed in Figs. 16 and 17. Box-type gutters, Fig. 4, also are used extensively and the fittings and method of attachment vary considerably. Ordinarily gutters come in 8 to 12-ft. lengths, with 10-ft. lengths being perhaps the most commonly furnished. Corner fittings and drop outlets are separate units. Leaders connect gutters to downspouts in most types of installations. When ordering the materials and parts for a major replacement job be sure to include a sufficient number of hangers, Fig. 16, to permit a 4-ft. spacing throughout the length of the gutters. Order 1-in. nails for fastening the hangers and obtain all the slip-joint connectors required. Order leaf strainers for each drop outlet, and also get the proper type of downspout hangers, or bands. If only one or two sections of the gutter require replacement, measure the old ones and renew with the same type and size. When hanging new gutters, don't forget to make sure that the pitch is the same as that of the one being replaced.

Installing gutter hangers: New hangers should be nailed to the roof boards and not over the shingles, as exposed nails are likely to rust away in time and cause a leak. Removing shingles to expose the roof boards

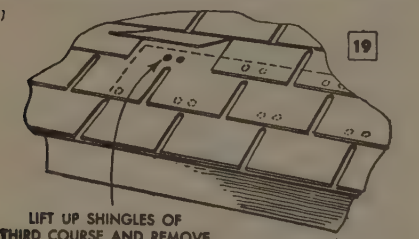


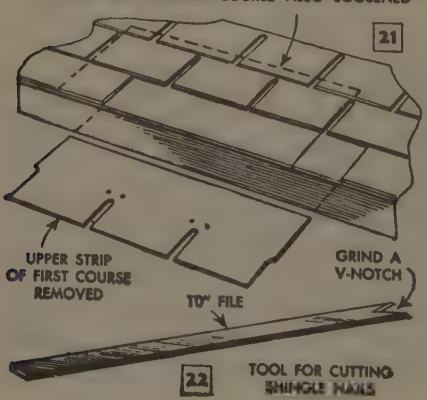
Applying protective compounds to the inside surfaces of downspouts pays off by greatly increasing the useful life of these parts. Material is applied to the inside surfaces with an improvised brush





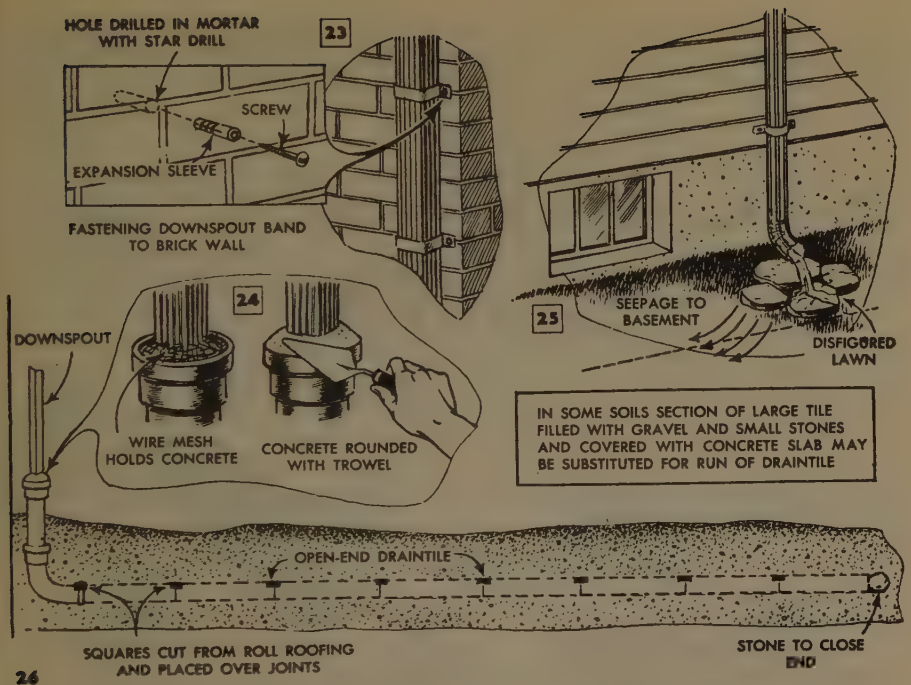
When applying new gutter hangers on old roofs, shingles should be lifted so that hanger can be nailed directly to the roof boards. On asphalt-shingle roofs, the individual shingles are easily removed for this job





must be done with care to avoid damage. First, remove the nails from two or more individual shingles of the second row, or course. The nailheads are exposed by simply lifting up the butt ends of the third course as in Fig. 19. Pry up the nailheads with a wide-bladed screwdriver as in Fig. 20. To prevent damage to the shingle, place a strip of ⅛-in. metal or a short block of hardwood under the screwdriver blade as shown. Remember that the nails holding the second course of shingles usually go through the upper ends of shingles in the first course. Finally, removal of the nails holding the first course of shingles, which usually is of double thickness, permits you to pull the shingles out as in Fig. 21, exposing the roof boards. In some types of construction, especially on wide cornices, there will be a layer of roll roofing under the first course. It is not necessary, of course, to remove this, as the hangers can be nailed over it, provided all nail holes are sealed with roofing cement before re-laying the shingles. After prying off the old hangers and nailing on the new ones as in Fig. 18, drive the nail part way down, and then coat the area around the nail with roofing cement so that when the nail is driven down fully, the cement will form a watertight seal around the nailhead. Now, replace the double course of shingles, making sure that they are located in the same position as they were originally. Drive the new nails slightly to one side or the other of the old holes and, before driving them clear down, apply roofing cement around the heads to form a seal. Be sure all old nail holes are filled with cement. Finally, the loosened shingles of the second course are nailed down again to finish the job. The procedure is repeated at each new hanger position. In a general way the same thing applies to wooden shingles. However, these are more rigid than asphalt shingles and require a few variations in procedure. It is necessary to cut the nails holding each shingle with a special tool improvised from an old file, Fig. 22. The V-notch at one end is ground to a beveled edge and in use the tool is forced under the shingle until the V-shaped cutting edge contacts the nail. A few light taps on the outer end of the tool generally cuts the nail cleanly. When replacing a wooden shingle, the two lower nails are started at approximately the same position as the original nails. Fill the old nail holes with roofing cement. Pry up the shingles of the next course above, slip a piece of sheet metal over the nailheads and press the upper shingle down to force the nails home. Don't tap the shingle with a hammer as you may break it.

When hangers must be attached to metal


HOLE DRILLED IN MORTAR WITH STAR DRILL
23
SCREW
EXPANSION SLEEVE
FASTENING DOWNSPOUT BAND TO BRICK WALL
24
DOWNSPOUT
WIRE MESH HOLDS CONCRETE
CONCRETE ROUNDED WITH TROWEL
25
SEEPAGE TO BASEMENT
DISFIGURED LAWN
IN SOME SOILS SECTION OF LARGE TILE FILLED WITH GRAVEL AND SMALL STONES AND COVERED WITH CONCRETE SLAB MAY BE SUBSTITUTED FOR RUN OF DRAINTILE
OPEN-END DRAINTILE
SQUARES CUT FROM ROLL ROOFING AND PLACED OVER JOINTS
STONE TO CLOSE END
26

roofing, it's a common practice to solder them in place. Before soldering, the metal must be thoroughly cleaned, fluxed and preheated with a blowtorch. Downspout bands are simply nailed to wooden trim surfaces. However, when fastening the bands to brick, it is necessary to use masonry nails or screws. Screws are driven into expansion sleeves which are placed in holes drilled in the masonry with a star drill as in Fig. 23.

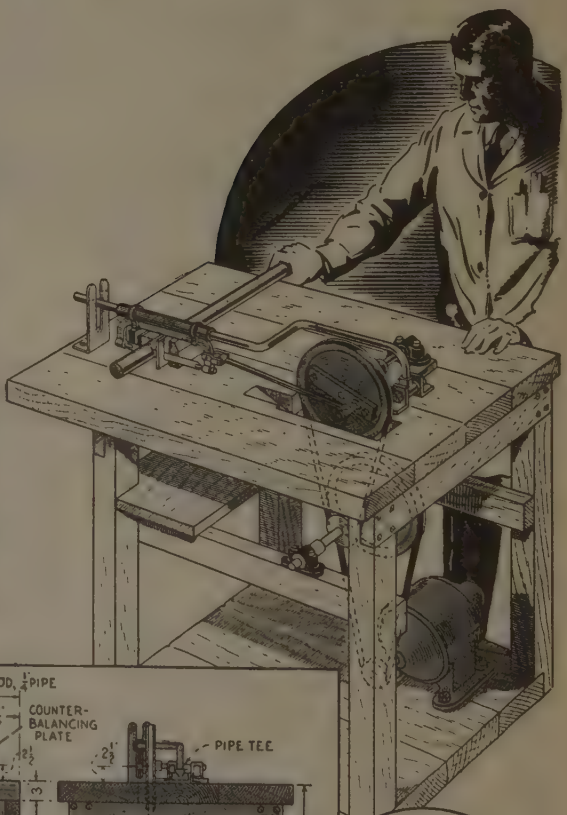
Cementing downspout into draintile: When downspouts are connected to draintile leading to the storm sewers, the opening where the downspout enters the tile should be sealed with cement mortar supported by wire mesh pressed into the bell end of the tile. Usually the bell end is only a few inches above grade and if the opening is not closed tightly, small stones, dirt and trash may clog the tile. To seal the joint, first cut and bend a disk of ½-in. wire mesh to fit into the open end of the tile. Bend up the edges of the wire disk so that it will wedge tightly in place. Then cut a round opening in the disk so that you can insert the lower end of the downspout. After the latter is in place, mix a heavy cement mortar and trowel it into the opening, building it up at the top to form a sloping surface that will shed water, Fig. 24.

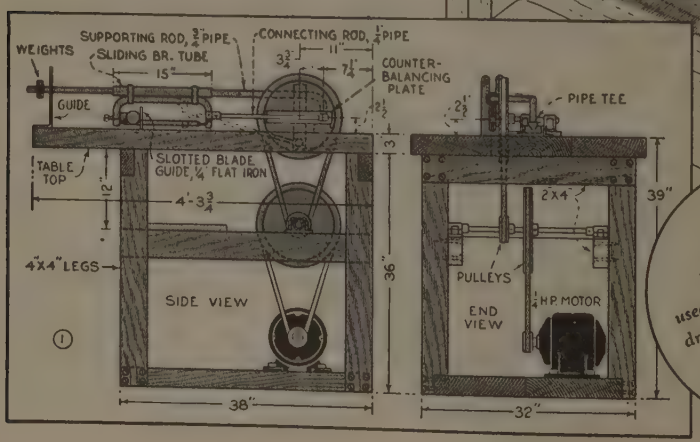
Installing splashers and draintile: When water from the downspout is discharged at ground level, some provision must be made for spreading the flow of water, as otherwise the force of the stream of water will wash away sod and soil. Also, if drainage from the foundation is poor, water may seep into the basement. Where there is ample drainage away from the foundation, a few flat stones placed below the end of the downspout may suffice as a splasher, Fig. 25. However, unless the arrangement is only temporary, it is better to install concrete splashers of sufficient size to direct the water away from the building in a spreading flow. In some soils, a run of open-end draintile installed below grade as in Fig. 26, will serve as a dispersal unit. Sometimes, builders install a long run of tile in this manner and place a section of large draintile (24 to 36 in. in diameter) at the lower end of the run. The large draintile section is placed on end with the bell end up and filled with coarse gravel and small stones to form a dry well. The top of the tile is closed with a cast-concrete cover. Sometimes a tile elbow is cast integral with the cover and the lower end of the draintile is led into the elbow. In gravelly or sandy soils, this installation works quite satisfactorily.

HACKSAW—POWER-DRIVEN

ANY ordinary hack-saw frame with the handle removed can be fitted to this simple drive unit, making an efficient power hack saw that will handle all kinds of light and medium work.

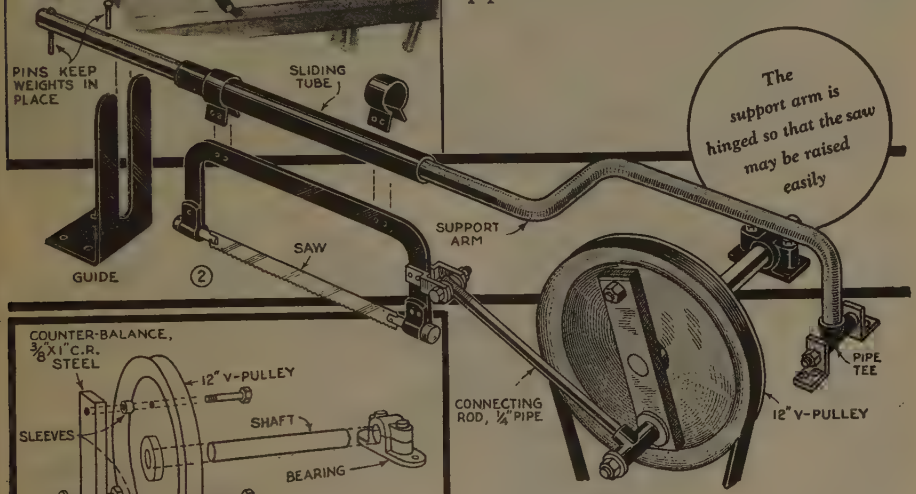
Fig. 1 shows side and end views of the table and gives you a general idea of the assembly. You don't have to be particular about the dimensions of the table. The main thing is rigidity and sufficient weight to absorb vibration of the reciprocating parts. A ¼-hp. motor supplies the power through two sets of reducing pulleys, which brings the speed of the saw down to about 90 strokes per minute. The length of ¾-in. shafting which

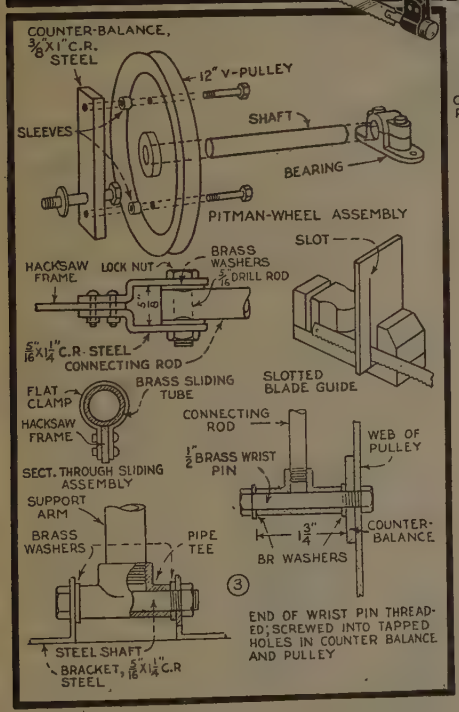




Any ordinary hand hacksaw can be used with this simple power drive. The saw frame is clamped to support arm, which is weighted

supports the intermediate and top pulleys turns in sets of ¾-in. babbitted split bearings. Note that setscrew collars are used on each shaft. One face of the top or driving pulley is fitted with a counterbalancing steel plate as in Figs. 2 and 3. The counterbalance is bolted to the pulley. Construction of the crankpin is shown in Fig. 3, the lower right detail. A section of ½-in. brass rod is threaded on both ends and screwed into a tapped hole in one end of the counterbalance and through the pulley. This crankpin is secured with a nut at the back of the pulley. A ¼-in. pipe tee which has been reamed to fit

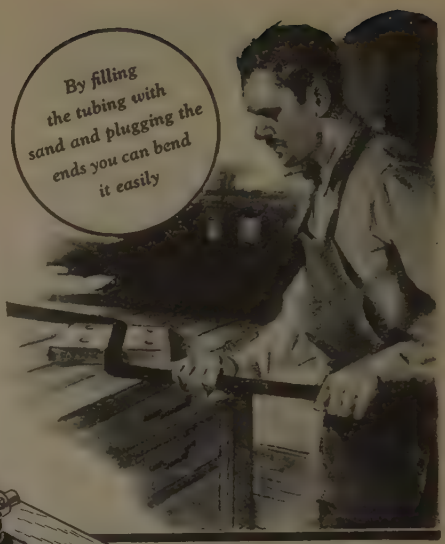


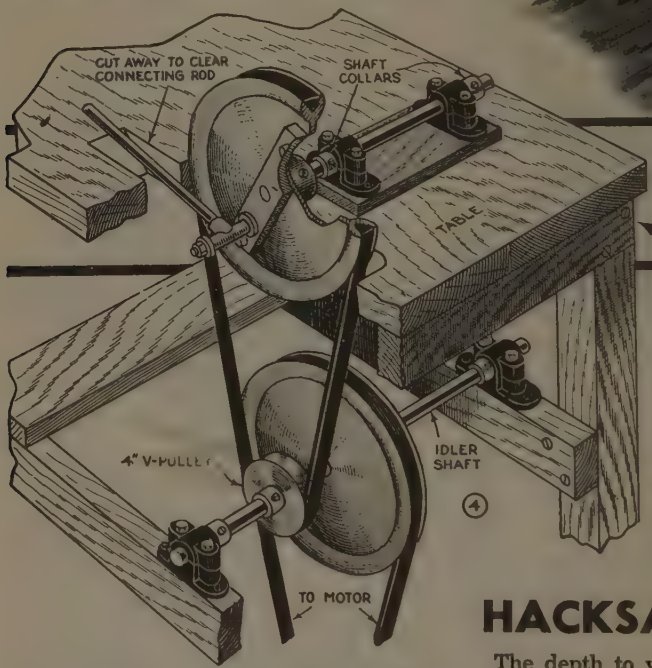


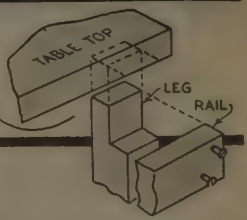
serves as a driver for the connecting rod which is made from a length of ¼-in. standard pipe. The forward end of the connecting rod is drilled for a 5/16-in. steel wrist pin threaded at both ends for lock nuts. The assembly is made as in Fig. 3. To guide the hack saw in a straight path, it is necessary to make a supporting arm either of ¾-in. inside diameter iron pipe or brass tubing of the same size. Figs. 2 and 3 show the method of fastening this arm to the table. A ¼ by ¼ by ¾-in. pipe tee is used as the moving part of the bearing. The tee is reamed out to fit over a ½-in. steel shaft. It is necessary to make an S-shaped bend in the arm as in Figs. 2 and 3. The best way of making the bend is to fill the ¾-in. pipe with sand and place caps on each end, heat to a dull red and bend carefully in a vise. Brass tubing

can be bent cold. The surface of the pipe which supports the hack-saw guide should be polished smooth. The slide is a length of brass tubing which will telescope over the polished section of the supporting arm. The hack-saw frame is fastened to the guide with the aid of clamps as in Fig. 2. These can be riveted to the saw frame or held with small bolts.

The pressure applied to the blade when cutting is regulated by weights on the outer end of the supporting arm as shown in Fig. 1. These weights can be made by drilling a hole in cold-rolled steel plate of such a size that the piece will slip easily over the pipe. Setscrews or pins can be





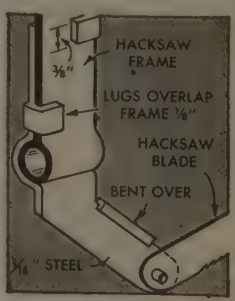


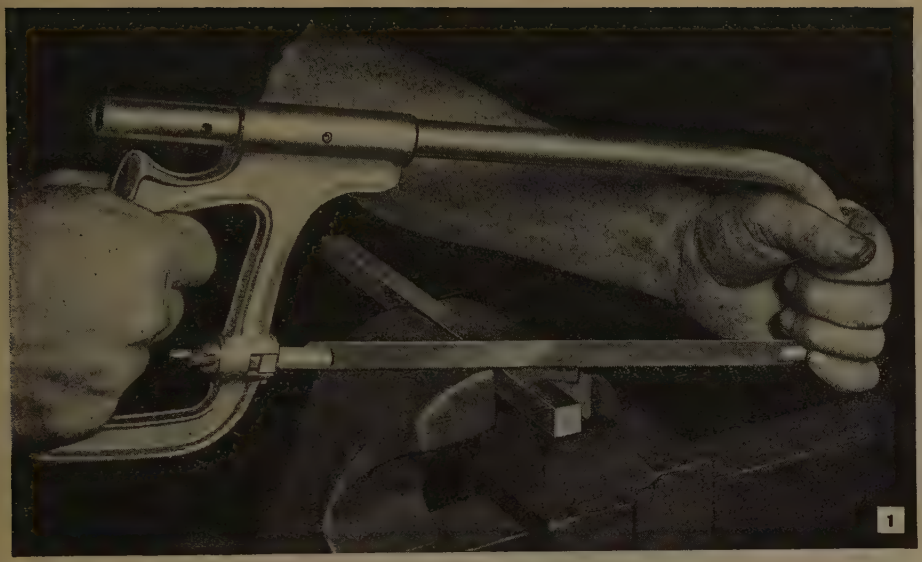
used to hold the weights in place. Different materials require slight variations in blade pressure for the best cutting action. The support-arm guide, Fig. 3, can be made from ¼-in. flat iron, the slot being of the same width as the diameter of the pipe. If necessary, the guide should be blocked up on the bench, so that the arm will reach the bottom of the slot just as the saw breaks through the work.

A standard toolmakers' vise can be used to hold the work. A slotted plate fitted in the vise guides the saw blade. The guide plate is fastened to one vise jaw with machine screws. Fig. 4 shows the assembly of the speed-reducing drive. All pulleys are of the V-type for ½-in. belt.

HACKSAW FRAME

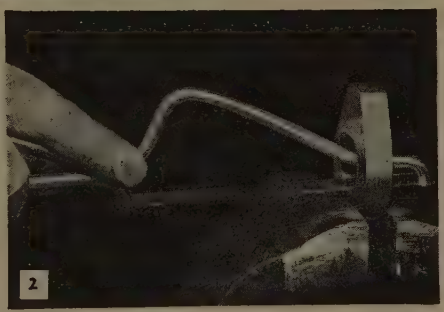
The depth to which your saw will cut can be greatly increased by adding an extension to the hacksaw frame. The angle at which the steel extension is cut must be such that the blade will fit on the pin. Two lugs overlap the saw frame to hold the extension in place and the third overlap furnishes necessary rigidity.





HACKSAW TECHNIQUE

Select the right hacksaw blade for the job and use it in a frame of approved design



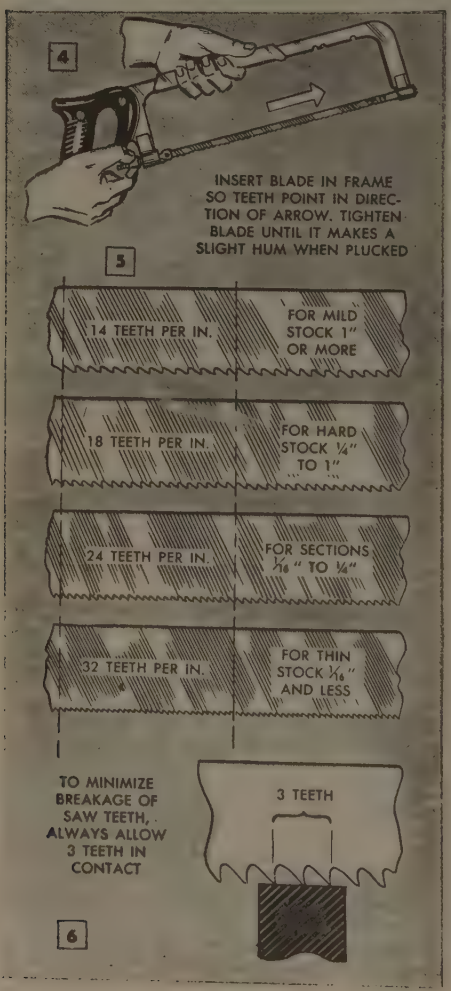
ACCURATE alignment of the frame and positive control of the direction of cut are the two essential requirements in hand hacksawing. That's why choice of a good-quality hacksaw frame of proper construction and proportions is important. The standard hand-hacksaw frame, one type of which is pictured in Fig. 1, must have all the features of proper balance, ample work clearance and a pistol-type grip contoured to give a natural easy handhold. The studs and pins which take the blade ends should be adjustable to face the blade in at least four directions and there should be provision for drawing the blade to the correct tension, either by means of a wing nut or a cam arrangement in the frame. For best results on average work, the lower end of the handle should be on the cutting line of the blade or slightly below it. This position of the handle utilizes the natural thrust of the arm to the fullest advantage on the cutting stroke and also facilitates positive control of the direction of cut. In addition to a variety of frames that are more or less standard, there also are a number of special frames designed for various purposes. One of these, made for working in drilled holes, is shown in Fig. 2. Similar hacksaw frames are available for working in holes as small as $\frac{5}{8}$ in. in diameter.

Inserting blade in frame: Most hacksaw blades are $\frac{1}{2}$ in. wide, .025 in. thick and are available in 10 and 12-in. lengths. Blades are inserted in the frame so that the teeth point away from the handle, Fig. 4. Tension on the blade should be sufficient to hold it true in the cut. When the blade warms, it will expand along the length and lose some of its original tension. Before tightening the tension nut, or the cam, be sure that the blade rests flat against the milled sides of the studs and that the pins are fully engaged.

Types of blades: Hacksaw blades are made for a variety of purposes and differ in toughness, hardening and tooth spacing. Ordinary blades are edge-hardened along

the line of the teeth to a point just below the gullets (spaces between the teeth), leaving the back of the blade softer and more flexible. Blades of high-speed steel generally are more wear resistant and capable of cutting much harder metals. They also are more resistant to breakage of the blade itself.

Blade hardness: Besides the flexible, general-purpose blade, there are all-hard, stiff-backed blades of various-gauges which many mechanics and toolmakers prefer. Although these blades are capable of making smooth cuts in very hard metals, they are rather brittle and break easily in materials that tend to flex. Both flexibility and hardness are combined in some blades made for special purposes. This type of blade is shown in Fig. 3. It is the best one to use where the cutting strains are severe.


4
INSERT BLADE IN FRAME SO TEETH POINT IN DIRECTION OF ARROW. TIGHTEN BLADE UNTIL IT MAKES A SLIGHT HUM WHEN PLUCKED
5
14 TEETH PER IN.
FOR MILD STOCK 1" OR MORE
18 TEETH PER IN.
FOR HARD STOCK ¼" TO 1"
24 TEETH PER IN.
FOR SECTIONS 1/16" TO ¼"
32 TEETH PER IN.
FOR THIN STOCK ¼" AND LESS
TO MINIMIZE BREAKAGE OF SAW TEETH, ALWAYS ALLOW 3 TEETH IN CONTACT
3 TEETH
6

Tooth spacing: Tooth spacing is one of the important points in job selection of hand-hacksaw blades. Common blades come in four general tooth spacings: 14, 18, 24 and 32 teeth per in., Fig. 5. The coarser blades are usually recommended for cutting work of fairly large cross section in mild steel, cast iron, brass and bronze, and also for cutting aluminum, copper, hard rubber, fiber and certain other materials requiring ample chip clearance. Blades of 18-tooth spacing are advised for cutting hard materials such as tool steels, bronze, drill rod, etc. Blades of 24 and 32-tooth spacings are used to cut metals of thin cross section such as ⅛-in. angles, tubing and pipe. The finest blades are used to cut thin-walled tubing, conduit, sheet metals less than 18 gauge in thickness, and small rounds, such as ⅛-in. drill rod. In choosing a blade for the job, the important thing to remember is that at least three teeth should engage the metal simultaneously as in Fig. 6. This avoids stripping the teeth, or damaging the work, and gives a smooth cutting action similar to that of a file, Fig. 10. For solid rounds and bars, use the coarser blade, Figs. 11 and 12.

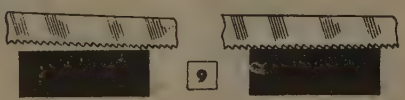
General cutting technique: Grip the work in a vise and scribe the cutting line close to the vise jaws, Fig. 7, to prevent the work from flexing and pinching the blade. Notch the edge at the scribed line with a file so

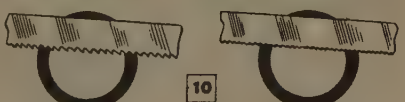
that the cut can be started easily on the line. Don't start the cut across the entire surface of flat work, as the blade will skid sidewise because of the large number of teeth engaged. Start the cut at a slight angle with the surface as in Fig. 9. Hold the saw with both hands as in Fig. 1, and apply sufficient pressure on the cutting (forward) stroke to cause the teeth to engage uniformly. Relieve the pressure on the back stroke. To hold the cut to a scribed line use a long, sweeping, straight-line stroke that utilizes nearly the full length of the blade for cutting. Timing of the cutting speed should be about one forward and one return stroke in one second. Faster sawing with ordinary blades may produce sufficient heat to draw the temper from the teeth. Short, fast strokes increase the risk of breaking the blade and make it more difficult to follow the scribed line. When a blade breaks after long use, don't try to complete the cut with a new blade. It will bind because the teeth have a wider set than that of the worn blade. Turn the piece over and finish the cut from the opposite side. In cutting angles the job will be done faster if each leg (side) of the angle is cut separately as in Fig. 8. By sawing each leg individually, you can use a coarser blade than could be used if the legs were sawed straight through edgewise. Use the same technique when sawing flat stock up to ¼ in. thick. Grip the piece in the vise with the jaws bearing against the edges, not the flat sides, and start the cut by notching the edge of the stock at the scribed line with a file. Don't neglect this step whenever the cut must be started on a corner. It also is helpful when starting the cut on a round, as the notch serves to guide the blade on the first few strokes until it has cut deeply enough to be guided by the sides of the cut itself. The notch will also help to prevent the blade from skidding and damaging the surface of the material adjacent to the cut.

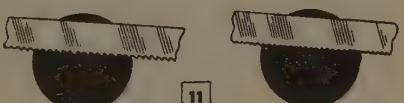
Use very light pressure when sawing thin materials. To cut thin sheet metals, it's a good idea to clamp the work between two pieces of wood as in Fig. 13, and saw through all three pieces as shown. This eliminates bending of the thin stock, as well as vibration, and breakage of blades. To make a cut along the edge of a large piece of flat stock, where the total depth of the cut will be deeper than the distance from the edge of the blade to the frame, set the blade holders, or studs, at right angles to permit the saw frame to clear the edge of the stock. This same position is used where there is insufficient clearance above the cut. Slots can be cut by using two or more blades side by side in the saw frame.

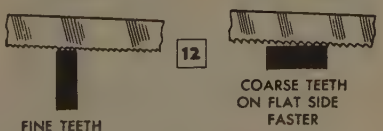
7

8
TEETH APT TO BREAK
SAW EACH SIDE SEPARATELY

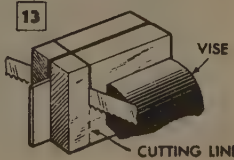

9
START CUT AT SLIGHT ANGLE
NOT OVER FULL SURFACE

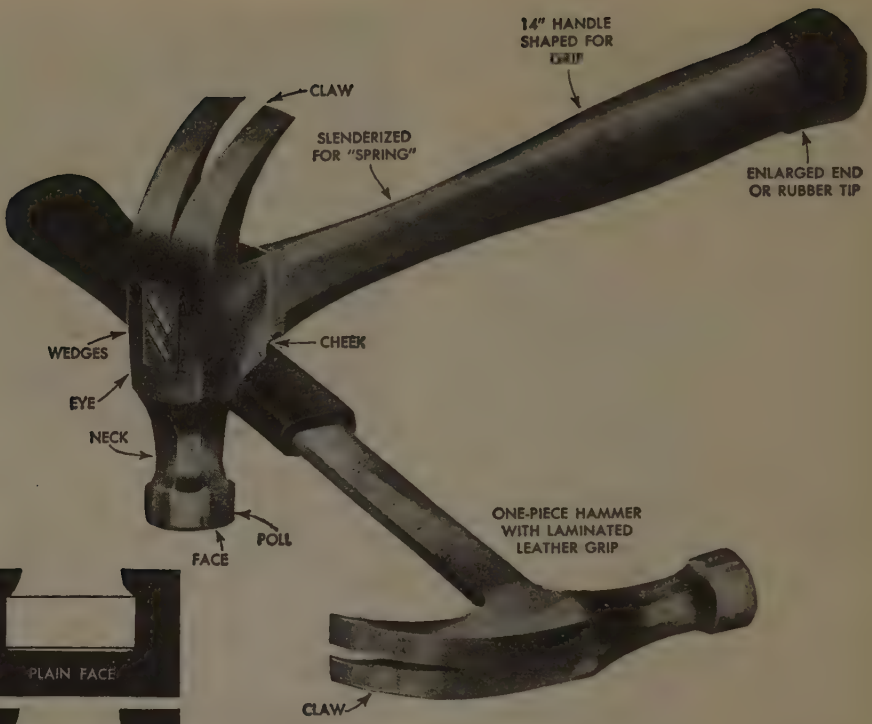

10
TEETH TOO COARSE
USE FINE-TOOTH SAW


11
AMPLE CHIP CLEARANCE
FINE TEETH WILL CLOG

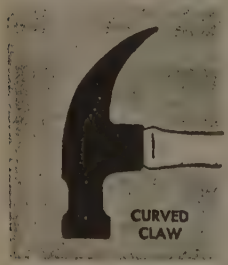

12
FINE TEETH TOO SLOW
COARSE TEETH ON FLAT SIDE FASTER

13
SAWING SHEET METAL CLAMPED BETWEEN WOODEN BLOCKS





Carpenters prefer hammer with a bell-faced poll

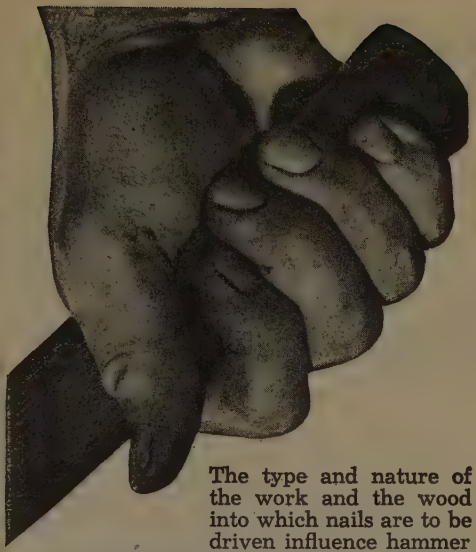


HAMMER TECHNIQUE

A GOOD HAMMER makes fewer "mistakes" and causes less fatigue than a poorly made one having a cast-iron head and an improperly shaped handle. A quality hammer is tough and durable, the head is heat-treated to give it just the right degree of hardness and the handle is made of straight-grained hickory especially selected and shaped to give the tool correct balance. The face of the poll is polished smooth and the edges are ground to a uniform bevel to prevent chipping. The angle at the neck of the poll gives the head sufficient toe-in to make the tool hang correctly. The claws are ground to "nipper" ends for getting into narrow spaces between nailheads and the surface of the work. A tapered slot between the claws has the right bevel to grip not only the head but also the body of a nail firmly. Handles are shaped to give a certain amount of spring to ease shock and minimize strain on the arm muscles of the user. Handles are flared at the butt ends and in some cases are fitted with rubber tips to afford an easy, nontiring grip. Some hammers have handles of steel, forged integral with the head and fitted with laminated leather disks to form a comfortable, shock-absorbing grip.

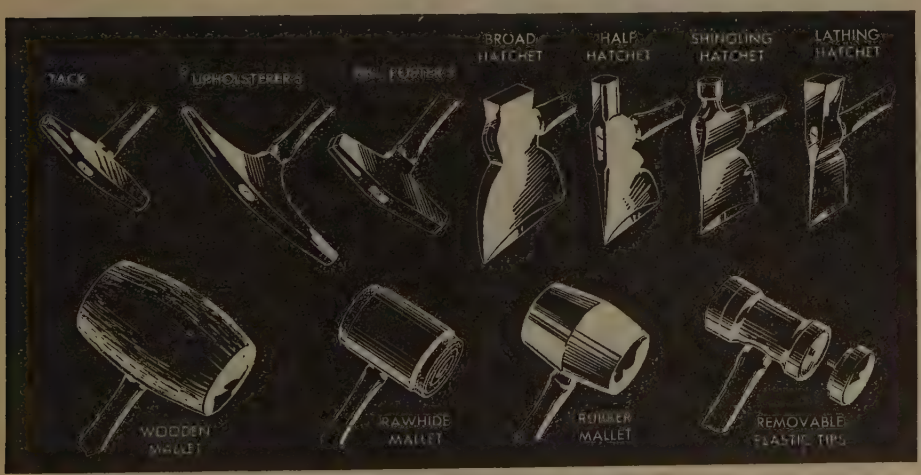
Sizes and types of claw hammers: Claw hammers come in various weights, 5, 7, 13, 16 and 20-oz. heads being more or less standard. Some manufacturers also indicate hammer sizes by numbers. These range from 1 to 4, No. 1 being the largest and No. 4 being the smallest. A No. 1½ hammer with a 16-oz. head usually is selected as the size being best for all-around use.

If misdirected hammer blow bends nail as in detail A, it usually is possible to correct fault by striking a second blow at an equal opposite angle, detail B. When nail is deflected by oblique grain as at C, strike it with hammer head angled in the opposite direction, detail D



The type and nature of the work and the wood into which nails are to be driven influence hammer size selected for a given job. Hardwoods require a greater driving force and a heavy hammer may be needed to save time and conserve the energy of the user.

Although the face of the poll is always crowned there are variations in the degree of the crown, or convexity. Finishers working on interior trim like a hammer with a pronounced crown, or bell face, on the poll, as this enables them to drive a nail flush or slightly below the surface of the wood without denting it. However, such a hammer requires skillful handling and for ordinary work users generally select a hammer having less crown. Ordinary claw hammers are regularly supplied with two styles of claws. On the first, or common claw hammer, the claws have a pronounced



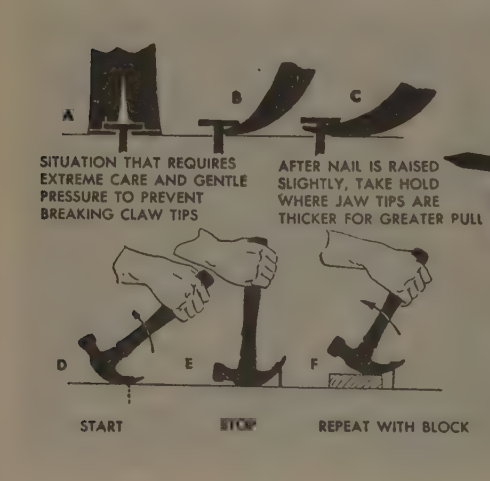
curve making them especially suited to pulling nails. On the other style the claws are very nearly straight and are heavier which adapts them for prying and for ripping off siding or roofing boards.

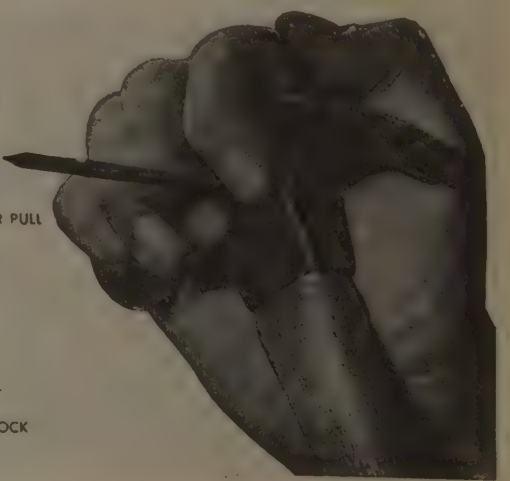
Using a claw hammer: Grip the hammer near the end of the handle. This hold gives the maximum leverage, power and drive. When fine work requires the ultimate in control you'll see experienced users extend the thumb along the handle, especially when handling a light hammer on fine work where the blow that isn't pin-pointed may cause irreparable damage. The trick in starting a nail is to use light taps with the hammer, holding the handle approximately at right angles to the axis of the nail and utilizing the wrist as a pivot. Master this trick and you won't injure your fingers, even when starting nails in difficult positions. After starting, or setting, the nail use the full stroke. When heavy blows are required, the wrist, forearm and upper arm are brought into simultaneous use to deliver the full driving power of the hammer. The movement is timed in such a way that at the moment of impact the hammer handle is in a position approximately at right angles to the axis of the nail, just as in the procedure of starting a nail. As the head of the nail nears the work surface the force of the blows should be lessened as otherwise the nailhead may be sunk below the surface far enough to break the wood fibers. It is particularly important to avoid this when installing wooden siding.

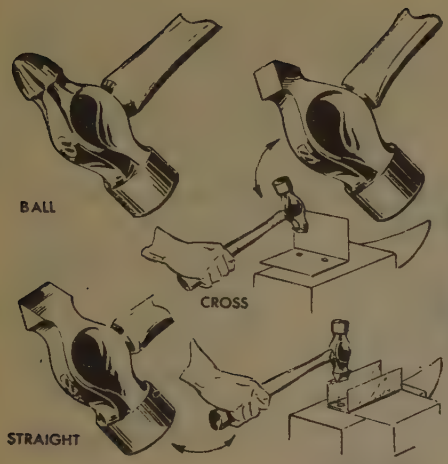
Should a nail bend slightly due to its striking a knot or oblique grain, it usually is possible to correct the condition simply by striking the head of the nail at a slight angle or slightly off center in a direction opposite to that of the bend. In hardwood, nails frequently start to bend when the point strikes wood grain of greater density. Often the nail can be driven home by striking it a sharp blow at an angle, causing the point to penetrate the adverse grain without increasing the degree of bend. When the character of the work makes it necessary to drive a nail directly through a knot, always drill a pilot hole of a diameter slightly smaller than the body of the nail. In fine work with hardwoods, finishers make a practice of drilling pilot holes before driving and setting finishing nails.

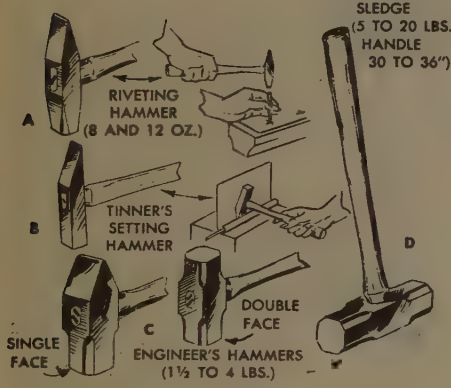
When pulling a nail where the head projects above the surface of the work sufficiently to permit wedging the tip of the claw under it, proceed by stages as undue pressure may break off the nailhead. Raise the nail slightly, then release the claws and take another bite. When pulling a nail, the initial stroke should be stopped just before the poll of the hammer contacts the surface of the work, as the leverage is greatly reduced when the poll becomes the fulcrum. Lift the hammer and insert a block or wedge before applying pressure in the second stage. When using a hammer to pull nails, the pressure always should be moderate to avoid breaking the handle or loosening it in the socket, or eye. When you find yourself in a position with only one hand free you can start a nail easily by gripping the nail and hammer together in one hand. The head of the nail bears against the side of the hammer at the midpoint and a forceful push or a light tap will set the nail so that it will stay in position.

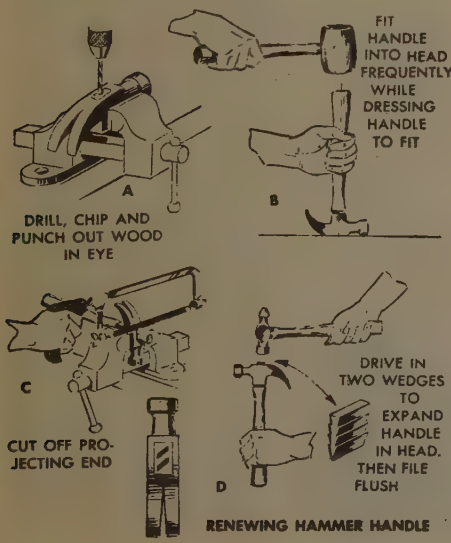
Care of hammer: For the safety of yourself and others who may be near by, never use a hammer with a loose head. Take time to put in new wedges or install a new handle. When the tool is not in use keep











the head oiled to prevent rusting. Wipe off the oil before using.

Tack hammers: Use a 5-oz. regular tack hammer, a 7-oz. upholsterer's hammer or an 8-oz. bill-poster's hammer for driving tacks. Hammers having one poll magnetized for holding the tack while starting are preferred by most users. The magnetized poll is used only for starting the tack.

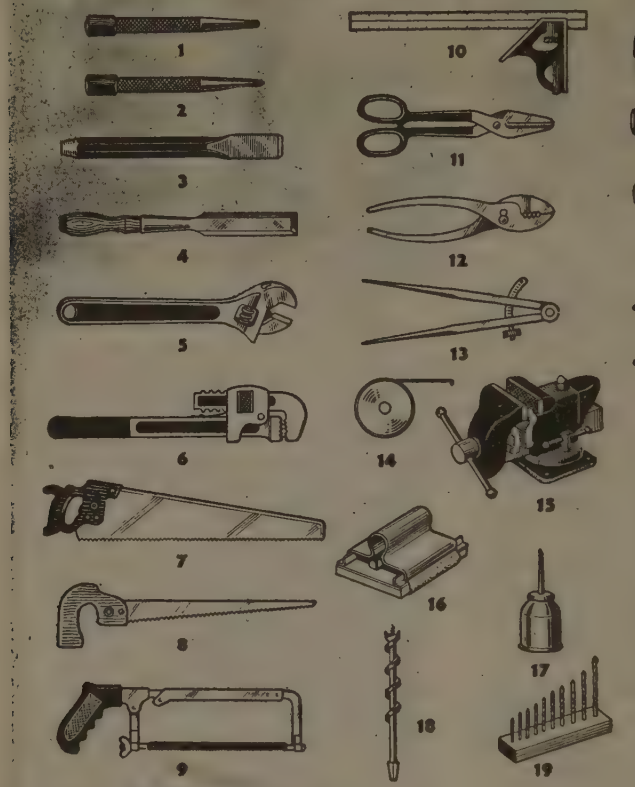
Hatchets: Ordinary hatchets used by lathers and roofers have a polled head with a cross-checked face for driving small nails. The narrow cutting blade is adapted to trimming wooden lath and shingles. The various types are shown on page 234.

Mallets and soft-faced hammers: Wooden mallets are generally used to drive wood chisels. Soft-faced hammers made from various materials such as rawhide, rubber and plastic are adapted to striking finished or polished surfaces of metal without marring or denting the work. Some types of soft hammers have interchangeable tips of various materials.

Mechanic's hammers: Three types of ball-peen hammers are illustrated, also several types of heavier hammers adapted to bending and riveting of sheet metal, driving cold chisels and similar jobs. Note that the peening hammers shown in the upper left-hand detail have both round polls (ball peen) and wedge-shaped polls (cross and straight peen) which adapt them to peening rivets as well as metal surfaces. Several special types, including engineer's hammers and small sledges are shown in the center details A to D inclusive.

Replacing hammer handles: Details at the lower left, A to D inclusive, show four essential steps in replacing a hammer handle. These steps apply to all types of hammers with only minor variations. When replacing the handle, never burn the old wood out of the eye as the heat may draw the temper of the head. ★ ★ ★

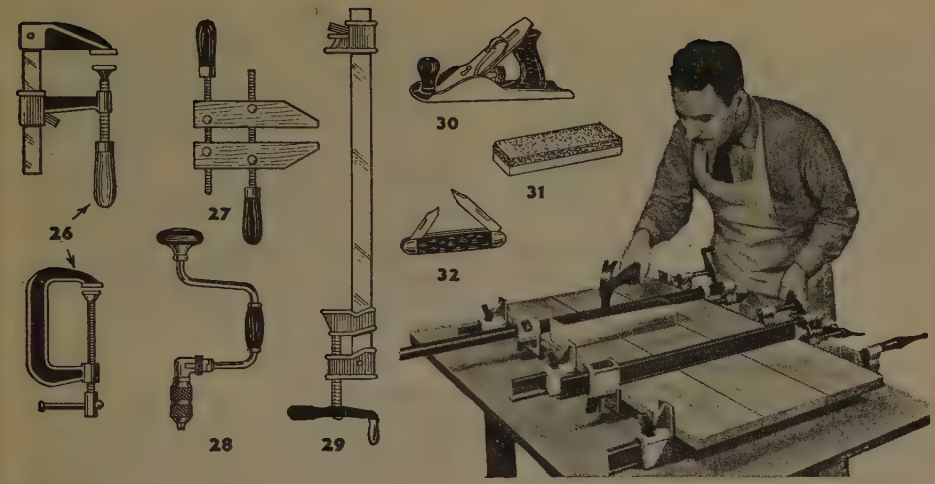
Hand Tools Come First....



IT IS OBVIOUS that any shop needs hand tools. However, the essential list is considerably less than required by the woodworker of 25 years ago. It numbers no more than 30 or 40 items, all of which can be purchased in good quality for about $50. Actually you don't go out and buy these basic hand tools all in a chunk, because the average man in a position to have a home workshop is normally already well-stocked with hammers, saws and most of the other items. They are household necessities and are only incidental to the business of starting a home workshop.

A good basic list comprises the 30 essential tools illustrated and tabulated on these pages. While the list might be increased endlessly, it is also true that with these basic items you can do most of the ordinary jobs encountered in crafting. Every piece is a workhorse compared to other tools which you may use only once or twice in a lifetime.

The average crafter expands his collection of



hand tools slowly, buying two or three extra pieces each year as the particular need for them arises. For example, you may go along for a couple years without having any need of long bar clamps and then, overnight, run into a job of gluing a big panel where they become an absolute "must." Right there you put your tool money into clamps — and that particular setup is solved for the rest of your life. What you buy other than the essential hand tools is largely determined by the kind of work you get into. A woodworker can go along for years without once feeling the need of special wrenches, while the more mechanically minded person will get a full set of sockets and numerous special wrenches needed for his work.

There are two rules governing the selection of hand tools: (1) Buy what you need as you need it, (2) buy only good quality. It is a waste of time to do without some tool which you actually need; it is a waste of money to buy a half dozen cheap cold chisels when all you need is just one good cold chisel. Practically all tools of which you have more than one should be weeded-out from time to time, discarding the tools which are actually of no value. This applies particularly to files, which tend to be carried on the tool panel long after their useful life is spent. Some tool panels show as many as 40 different pliers, many in duplicate. How many pliers can you use at once? All along the line, the average crafter has a tendency to work with too many hand tools, which simply clutter the workbench. Some shops have as many as six nearly identical claw hammers, yet the owner can never find a claw hammer! It is perfectly true that if you have two of any tool, you misplace both of them often.

✓ Check List of HAND TOOLS

1. NAILSET ☐
2. CENTER PUNCH ☐
3. COLD CHISEL, ⅜" ☐
4. WOOD CHISELS, ½" and 1" ☐
5. ADJUSTABLE WRENCH, 6" ☐
6. PIPE WRENCH, 10" ☐
7. HAND SAW, 26" blade, 8 point ☐
8. COMPASS SAW, 12" blade ☐
9. HACKSAW, 10" or 12" ☐
10. COMBINATION SQUARE, 9" or 12" ☐
11. TIN SNIPS, 12" ☐
12. UTILITY PLIERS, 6" ☐
13. DIVIDERS, 8" ☐
14. PULL-PUSH STEEL RULE ☐
15. BENCH VISE, 3½" jaws ☐
16. SANDPAPER HOLDER ☐
17. OILCAN ☐
18. AUGER BITS, ⅜", ½" and ¾" ☐
19. TWIST DRILLS, Set of 10 to ¼" ☐
20. CLAW HAMMER, 16-oz. head ☐
21. PUSH DRILL, with points ☐
22. SCREWDRIVERS, 4", 6" and 10" ☐
23. FILE, 6" slim taper ☐
24. FILE, 12" bastard ☐
25. FILE, 12" rasp ☐
26. CLAMPS, six deep-bar or C ☐
27. HANDSCREW ☐
28. BIT BRACE, ratcheted, 10" sweep ☐
29. LONG BAR CLAMP ☐
30. JACK PLANE, 14" long ☐
31. COMBINATION OILSTONE ☐
32. POCKET KNIFE ☐

HANDLE REPLACEMENT

DO YOU HAVE a favorite old rake out in the garage from which the handle is missing? Or a spading fork with a taped handle that splits a little more each time you use it? If you've been planning to replace these or other garden tools this year but haven't bought the new ones yet, why not pause to look around? See how many good tools you could have just by fitting the old broken ones with new handles.

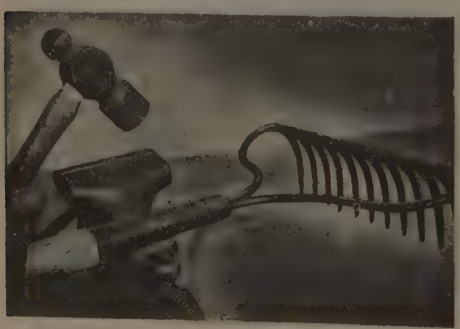
Fitting tool handles can be done easily with ordinary hand tools. The photos on these pages take you through the basic steps of applying new handles to a rake, spade, spading fork or ax. You will note that the rake tang is pinned to the handle, so care must be taken to drive the handle all the way onto the rake to align the holes in the handle and tang. As shovel handles are made in a variety of shapes, it is best to take the blade with you when buying a new handle for your shovel.

A hammer handle is fitted in much the same way as the ax handle pictured in the photo sequence, except for shaping the handle to fit the eye. Most hammer heads have an eye which tapers both ways from the center of the head. Therefore, cut down the end of the handle so its fits through the eye and projects approximately ½ in. beyond the head. Taper the handle to suit the eye on the handle side of the head. When the head is mounted on the handle, the latter is spread to fit the outer section of the eye by driving a wedge into the wood. End of the handle is cut flush with the head.

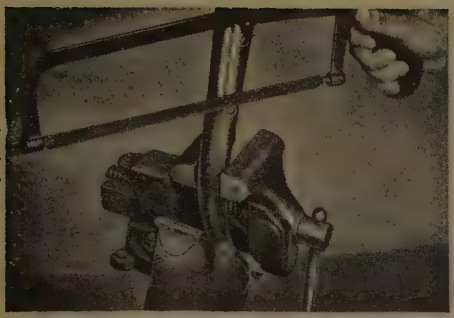
If rake handle cannot be removed after prying out pin, saw off handle as close to ferrule as possible

Using metal drill, remove wood to loosen the tang, and with a punch, drive the tang from the ferrule

After shaping new handle to fit ferrule, drive ferrule on end of handle as above. If necessary to enlarge hole in handle to take rake tang, drill as below, using bit about 1/16 in. smaller than tang



To attach handle, drive tang into hole by tapping on handle. Drill through hole in ferrule until bit strikes tang and drive pin in hole to engage tang. Joining tang and ferrule properly aligns the holes



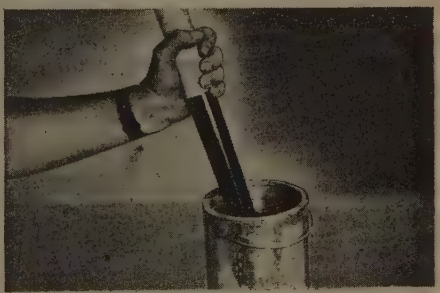
To remove handle from spade, cut off rivet heads with hacksaw or center punch and drill them out

Then clamp ferrule of spade firmly in vise and drive cutoff rivets from handle with a punch

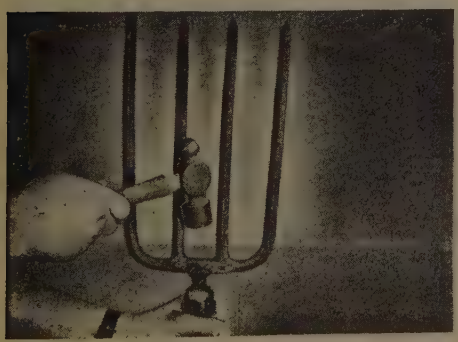
Shape end of the handle with a rasp so it can be driven fully into ferrule for maximum strength

After driving handle in ferrule, drill for rivets. Latter should extend about ⅛ in. before peening

Remove spading fork from handle by tapping close to handle, as above. To replace, insert tang in new handle and tap fork between tines, as below



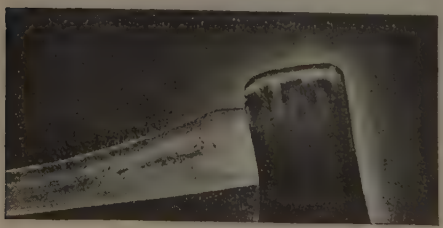
Above, soak fork handle in hot water for a half hour before fitting. Shovel handles, below, sometimes must be shaped or cut away to fit ferrule



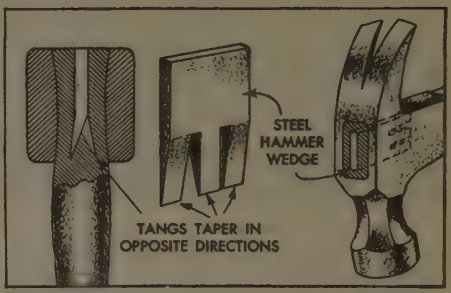
Saw off broken ax handle at head and drill wood in eye with metal bit. Remove wood with a punch

Clamp new handle in vise and rasp to fit eye, checking fit with ax head as shaping proceeds

Slot handle for softwood wedge, above. Check fit, below, with ax on edge. End of handle and blade edge ⅔ from front should touch bench top



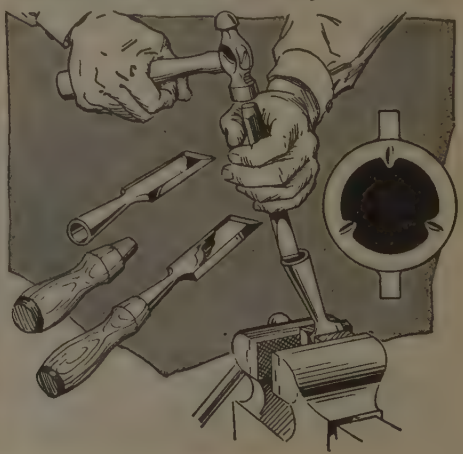
HANDLE WEDGE



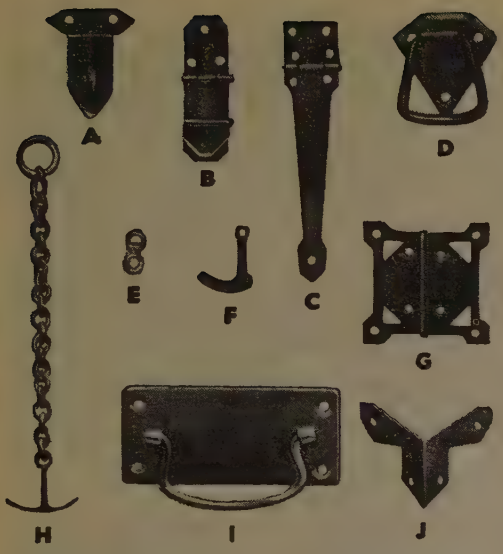
If you have trouble keeping a steel wedge from working out of the end of a tool handle, use a wedge like the one shown, which can be made from a flat piece of metal. Slot it in two places to provide three equal parts or tangs. Then bevel or taper the two end tangs on one side only and the center tang on the opposite side. When the wedge is driven into the end of a handle, the tangs will bend slightly in opposite directions and thus secure the wedge firmly in place.

HANDLES

Having the ferrules of a wood chisel become loose is annoying. The trouble can be corrected by peening or notching the inner edges of the ferrules with a cold chisel, as indicated. Tiny prongs or barbs formed by this procedure become embedded in the wood when the handles are forced into place and hold them securely.



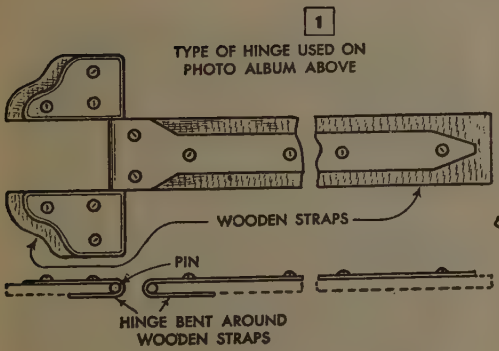
HAND-WROUGHT HARDWARE

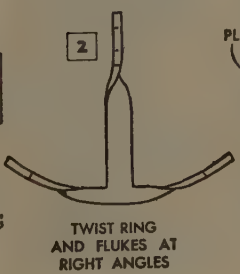


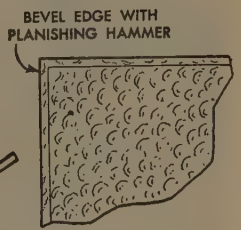
A—Hasp
B—Double-action catch
C—Half-strap hinge
D—Chest handle
E—Swivel
F—Hook
G—Pierced hinge
H—Chain and anchor
I—Drawer pull
J—Corner brace

SPECIAL hand-wrought hardware of polished copper or brass will add an attractive and personal touch to your craftwork. Such hardware, a few pieces of which are pictured and listed at the left, is difficult or impossible to purchase, but it can be made for practically nothing from scraps of soft sheet metal. Also, in making it yourself, the hardware can be designed expressly to suit the particular project.

The two examples given on these pages, the photo album and the glove box, show what can be done in combining metal and wood. The photo album incorporates hinges designed to simulate heavy strap hinges which are applied to a cover that is scored vertically to represent the individual boards of a door. The glove box, made in the form of a book, is bound with strap hinges and has a hasp to match the metal fittings sometimes used on a heavily bound volume. Soft sheet copper or brass, 22 or 24-ga., are the best materials to use as they can be cut easily



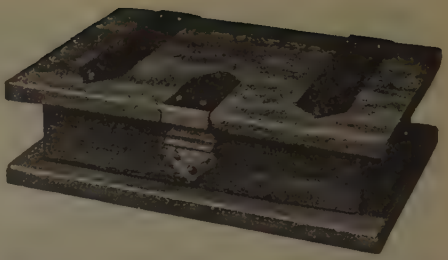




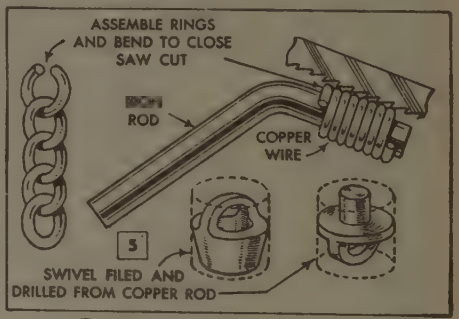
even with a pair of old scissors. Figs. 1 to 9, inclusive, give suggestions for making several simple pieces of special hardware. Fig. 1 details the strap hinge for the photo album. Note how the barrel of the hinge is formed by bending the ends of the metal around a nail and inserting the ends under the wooden straps. The anchor, Fig. 2, can be used purely as a decorative overlay, or it may be twisted as suggested, then attached to the end of a chain and used on a nautical project. The barrel joints of hinges and hasps, Fig. 6, are formed by cutting tabs on the ends of the parts and crimping them around a nail with pliers. The flat hook shown in Fig. 7 has a finger grip to facilitate engaging it in a flat staple.

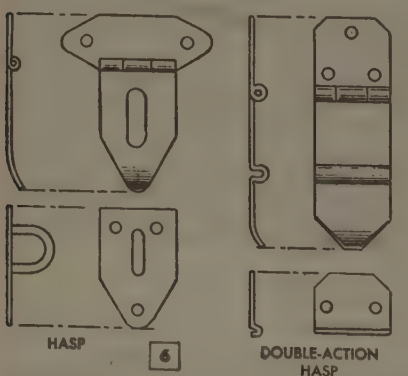
Outside corner braces of polished or hammered copper add both strength and ornamentation to fancy wooden boxes, Fig. 3. An attractive finish for these as well as the other metal fittings is produced by hammering the surface lightly with the round nose of a ball-peen hammer. Edges of the metal are beveled by tapping lightly with a planishing hammer, after which the surface is polished with steel wool and coated with clear lacquer.

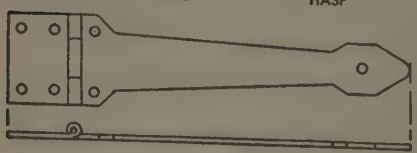
Figs. 4 and 5 show an easy way of forming the links for a decorative chain. Copper wire is wound around an iron rod of the proper size and then formed into links by sawing lengthwise through the wire winding. The links are assembled into a chain by interlacing them and squeezing the ends together. Such chain is suitable for ship-model fittings or other purposes where it is not subject to strain.

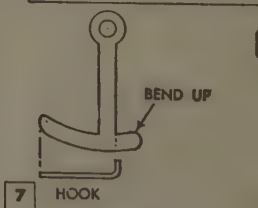


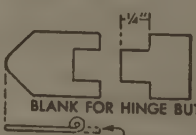
After winding copper wire around rod of proper size, the wire winding is cut lengthwise to form links

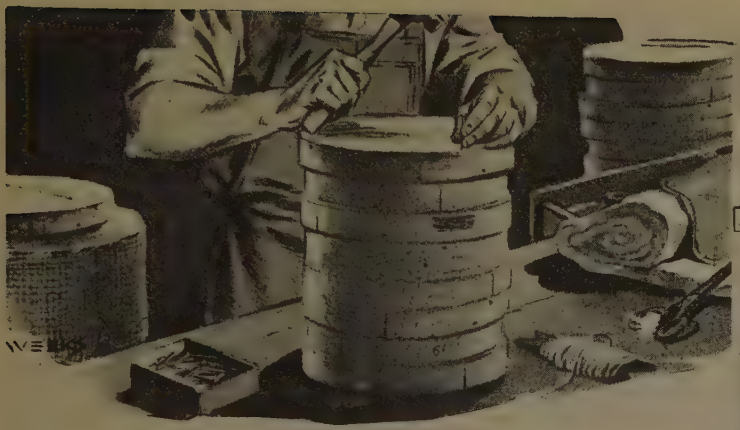












A

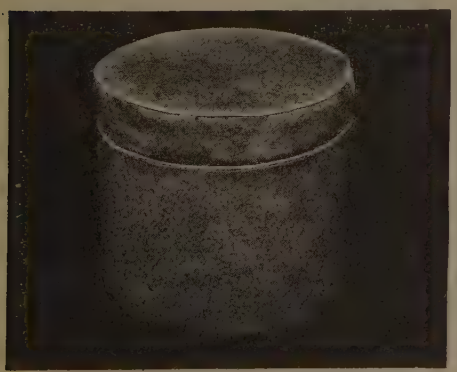
HASSOCK

B

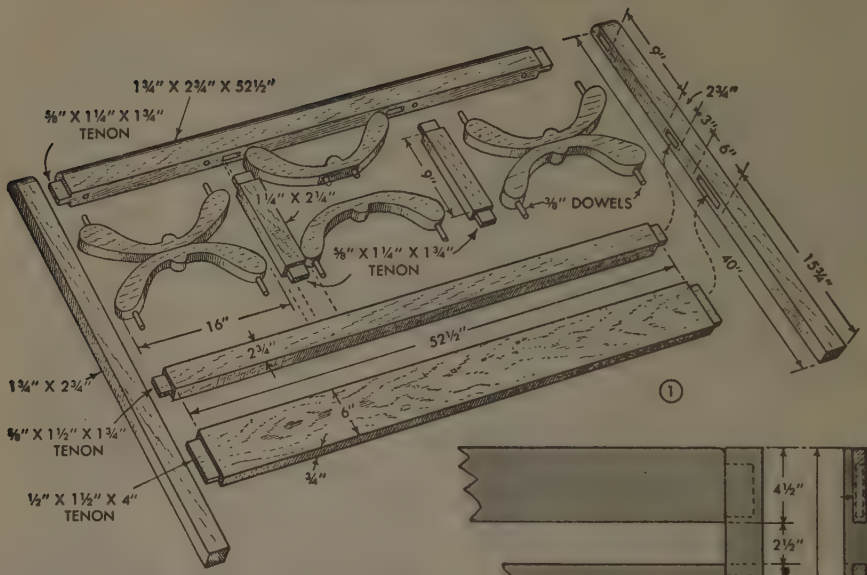
C

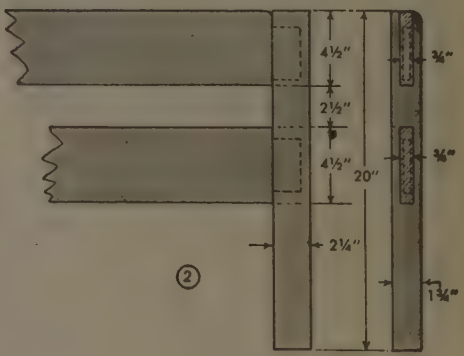
D

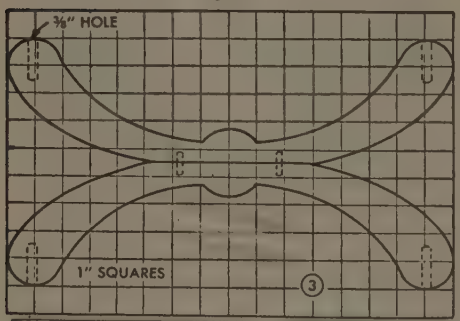
WHEN YOUR TV friends drop in and are offered one of these comfortable plastic-covered hassocks, they'll never know that they actually are sitting on cheeseboxes stacked on top of one another. But that's what Doris E. Beardsley of Yoakum, Tex., used to simplify and cut the cost of these smart hassocks to practically nothing. Most any neighborhood grocer will gladly let you have the empty circular wooden containers in which bulk cheese is packaged. These boxes measure approximately 5½ in. high and 14¾ in. in diameter. Two boxes make a hassock about 12 in. high when padded; three boxes make one that is chair height, or 17 in. First, the lid is nailed to the bottom box by driving short nails through the lower edge of the rim. The second box, with lid removed, is placed on top of the first box and then nailed to it through the bottom. Then the lid is nailed on as before and the step is repeated in adding each box. In upholstering a hassock, the cheesebox framework is first covered completely with cotton padding which is tacked here and there to hold it in place. Then a burlap covering in the form of a sack is pulled on over the cotton padding and tacked to the bottom of the hassock. The final covering is made in the form of a sleeve with a circular piece sewed in one end and a welt cording stitched in the seam. The welt is made by covering a length of cord with a 1¾-in. strip of the finish fabric as shown in the lower right-hand photo. If desired, two welt seams can be used, one being placed about 5 in. down from the top as shown in the lower left-hand photo.

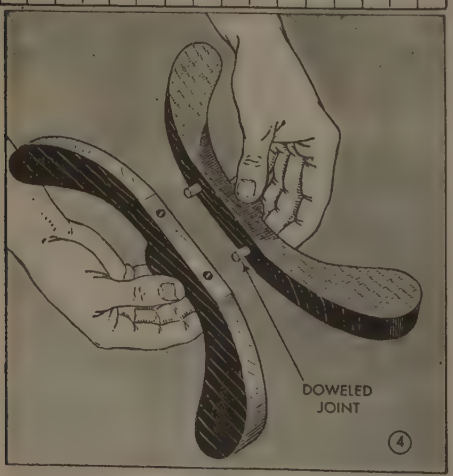


HEADBOARDS



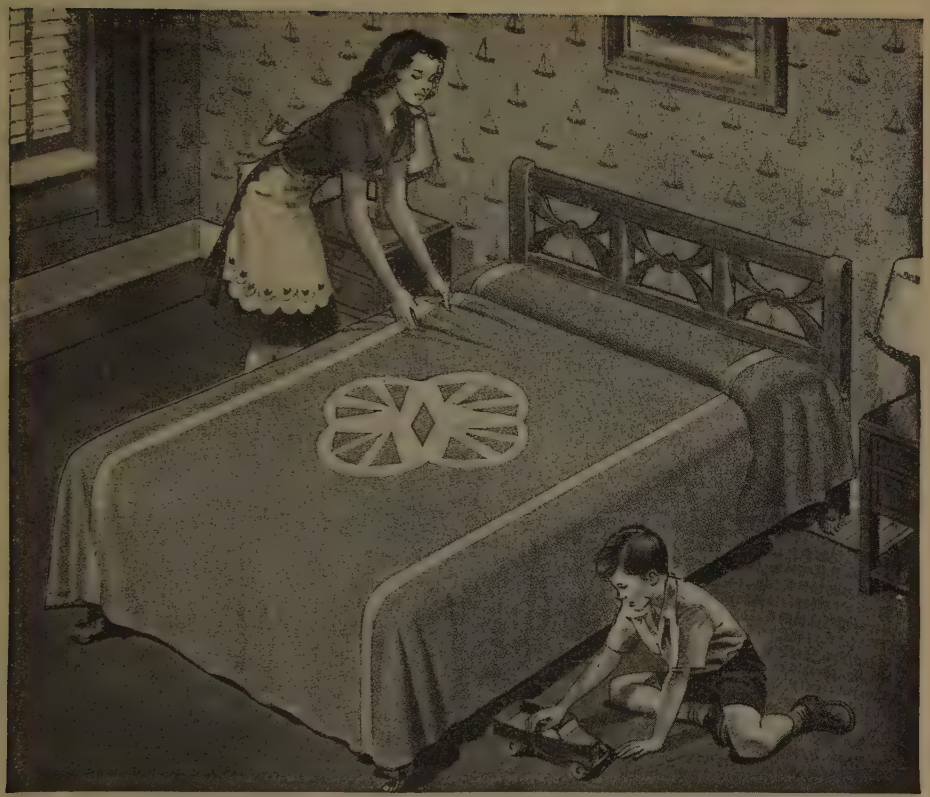






HERE you have the choice of remodeling an old bed, using the original side rails and other material if suitable, or starting from scratch and making an entirely new bed. The illustrations show the result of a remodeling job using original side rails and making the head and foot pieces from new material. Walnut was used for all parts, although any suitable cabinet wood such as oak, maple, birch or mahogany will do. The posts are made 1¾ in. thick, 2¾ in. wide and 40 in. long for the head, and 20 in. long for the foot piece. These are common proportionate heights.

For the head, three stretchers are needed, two measuring 1¾ in. thick and 2¾ in. wide, the other ¾ in. thick and 6 in. wide. Length will depend on the bed size —whether single or double. The width of this one is standard for a double bed. When slotting the posts for the side rails, be sure the centers are the correct distance apart

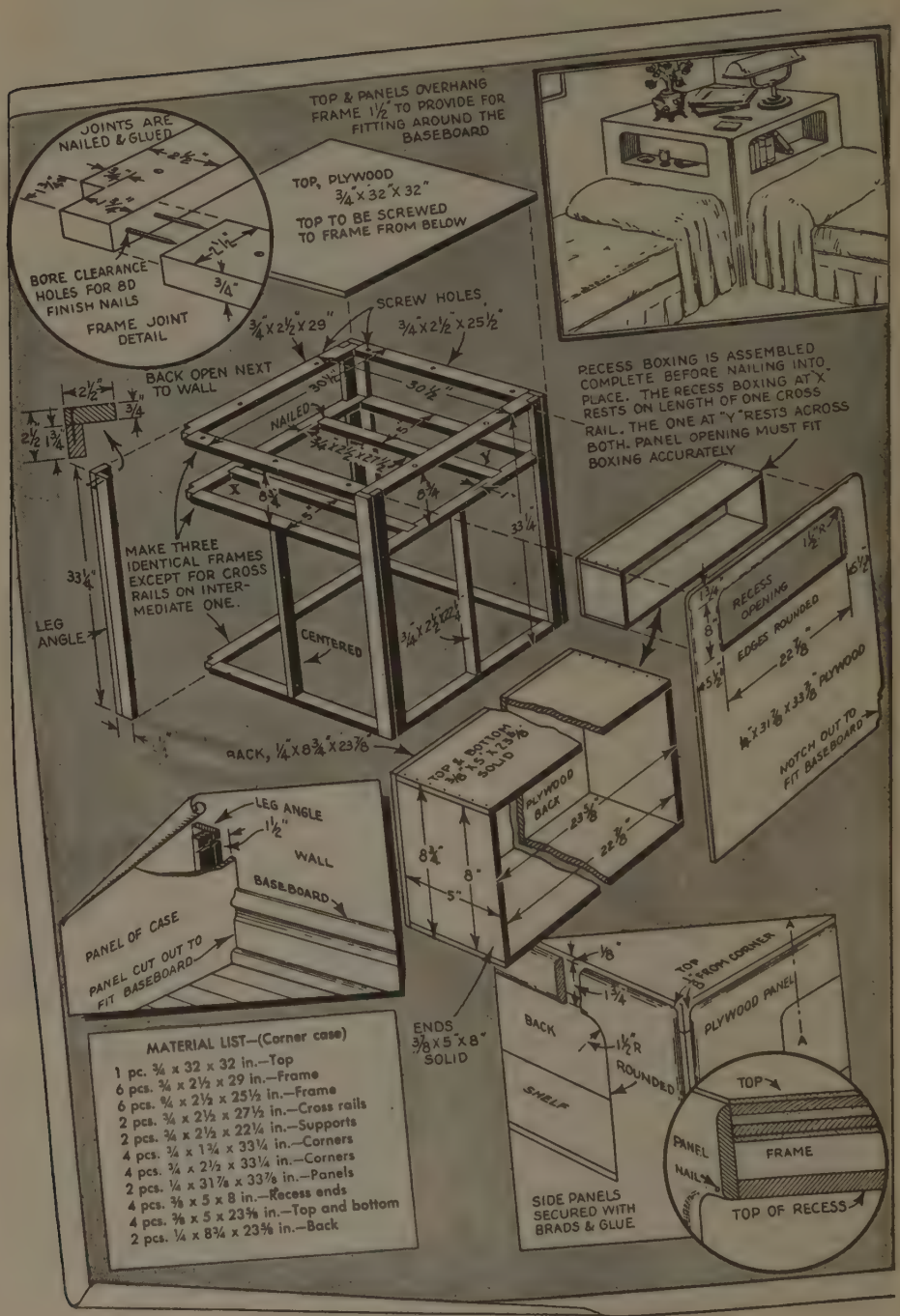


so the spring and mattress will fit. The uprights between the decorative sections are cut 1¼ in. thick by 2¼ in. wide. These are mortised into the stretchers as in Fig. 1. The three decorative sections are cut from stock a full 1 in. thick to the pattern given in Fig. 3 and, as you can see from the shape of these parts, it is necessary to do a thorough job of finishing before assembly. The two parts of each ornament are doweled and glued together as in Fig. 4. Be careful to wipe off all the excess glue before it dries. Join the parts of the head and foot pieces with mortise-and-tenon joints as shown in Figs. 1 and 2. Ornamental parts in the headpiece must be fitted into the assembly at the same time. Use glue in all joints and clamp until dry. Rounding off the top and front edge of the top stretcher is best done after the assembly is completed, as the square edges make the clamping operations easier and there is always the possibility of having to remove marks or scratches made by the clamp jaws.

The foot piece consists of two posts and two stretchers which are ¾ in. thick and 4½ in. wide. Study of the drawings will show how these are mortised together. Careful sanding of all the straight parts comes next. Good wood deserves a top-notch finish. Many craftsmen prefer the soft quality of a waxed surface to the hard gloss of a rubbed-varnish finish. If you have used an open-grain wood such as oak or walnut, then a filler is necessary. First stain the wood to the desired color, then add the same stain to the filler and apply the latter with a coarse cloth. Rub across the grain and then allow plenty of time to dry. Sand the surfaces lightly once again. Then follow with a sealer. When this is dry, rub smooth with fine steel wool. This simple treatment leaves an excellent base for a first-class wax finish.

Attaching the side-rail hooks or irons completes the job. If the available side rails have the type of hooks which fit into slots in the posts, this slotting and insertion of pins should be done before the parts are assembled. If it is necessary to make the side rails, use the length and cross-sectional size of a standard wood bed rail. No casters are used, the ends of the posts being rounded, smoothed and waxed. However, if casters are desired, the posts should be made approximately 1½ in. shorter.

HEADBOARDS FOR


JOINTS ARE NAILED & GLUED
BORE CLEARANCE HOLES FOR 8D FINISH NAILS
FRAME JOINT DETAIL
TOP & PANELS OVERHANG FRAME 1½" TO PROVIDE FOR FITTING AROUND THE BASEBOARD
TOP, PLYWOOD 3/4" X 32" X 32"
TOP TO BE SCREWED TO FRAME FROM BELOW
SCREW HOLES
3/4" X 2½" X 29"
3/4" X 2½" X 25½"
BACK OPEN NEXT TO WALL
NAILED
30½"
MAKE THREE IDENTICAL FRAMES EXCEPT FOR CROSS RAILS ON INTER-MEDIATE ONE.
CENTERED
33¼"
LEG ANGLE
RECESS BOXING IS ASSEMBLED COMPLETE BEFORE NAILING INTO PLACE. THE RECESS BOXING AT "X" RESTS ON LENGTH OF ONE CROSS RAIL. THE ONE AT "Y" RESTS ACROSS BOTH. PANEL OPENING MUST FIT BOXING ACCURATELY
RECESS OPENING
EDGES ROUNDED
22⅞"
4" X 31⅜" X 33⅜" PLYWOOD
NOTCH OUT TO FIT BASEBOARD
BACK, ¼" X 8¾" X 23⅞"
TOP & BOTTOM ⅜" X 5" X 23⅞" SOLID
PLYWOOD BACK
8¾"
8"
5"
LEG ANGLE
1½"
WALL
BASEBOARD
PANEL OF CASE
PANEL CUT OUT TO FIT BASEBOARD
ENDS ⅜" X 5" X 8" SOLID
⅛"
TOP
BACK
1¾"
1½" R
ROUNDED
SHELF
PLYWOOD PANEL
SIDE PANELS SECURED WITH BRADS & GLUE
PANEL
NAIL
FRAME
TOP OF RECESS

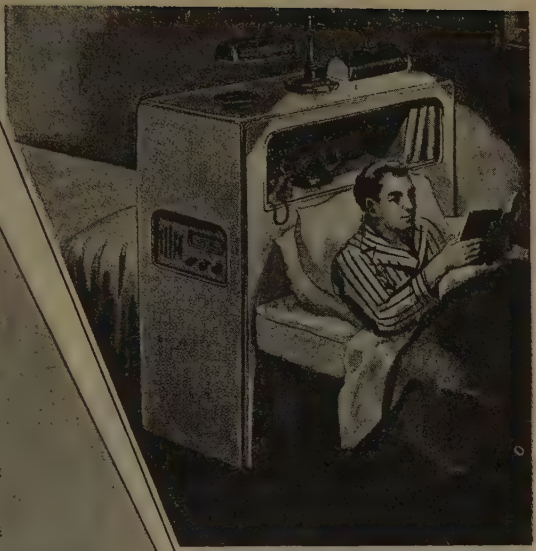
MATERIAL LIST—(Corner case)

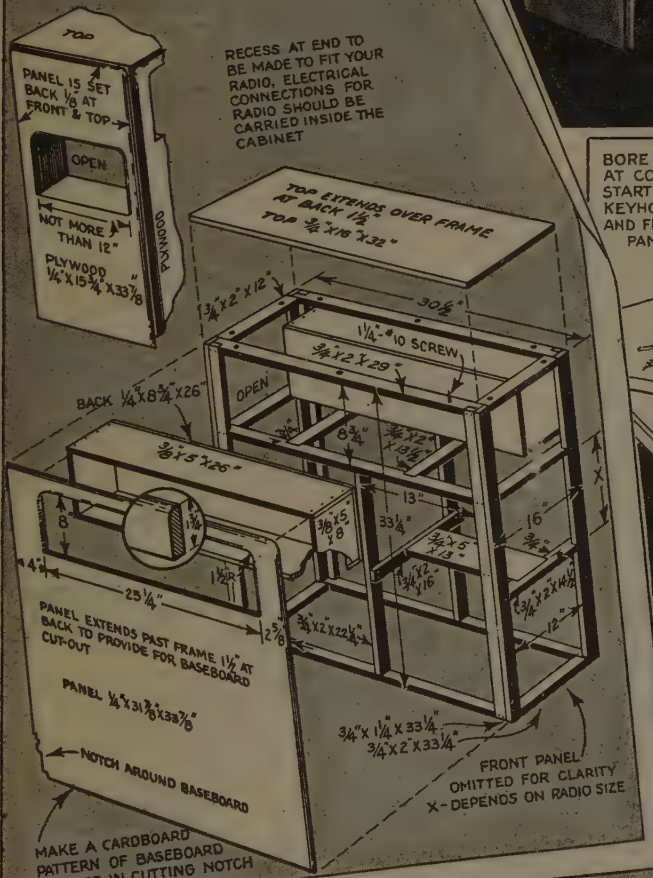
1 pc. ¾ x 32 x 32 in.—Top
6 pcs. ¾ x 2½ x 29 in.—Frame
6 pcs. ¾ x 2½ x 25½ in.—Frame
2 pcs. ¾ x 2½ x 27½ in.—Cross rails
2 pcs. ¾ x 2½ x 22⅛ in.—Supports
4 pcs. ¾ x 1¾ x 33¼ in.—Corners
4 pcs. ¾ x 2½ x 33¼ in.—Corners
2 pcs. ¼ x 31⅞ x 33⅞ in.—Panels
4 pcs. ⅜ x 5 x 8 in.—Recess ends
4 pcs. ⅜ x 5 x 23⅜ in.—Top and bottom
2 pcs. ¼ x 8¾ x 23⅜ in.—Back

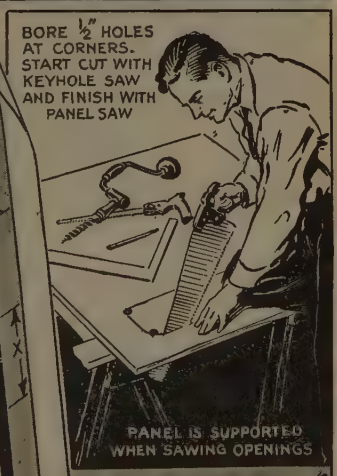
STUDIO BEDS

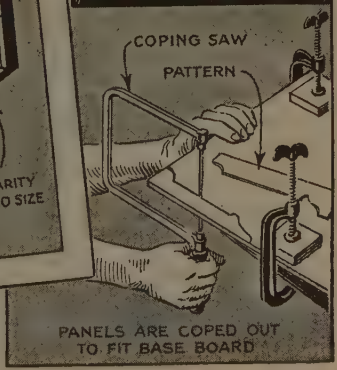
MATERIAL LIST—(Center case)

1 pc. ¾ x 16 x 32 in.—Top
6 pcs. ¾ x 2 x 29 in.—Frame
6 pcs. ¾ x 2 x 12 in.—Frame
2 pcs. ¾ x 2 x 13½ in.—Cross rails
2 pcs. ¾ x 2 x 22¼ in.—Vertical supports
1 pc. ¾ x 2 x 14½ in.—Rail
1 pc. ¾ x 2 x 16 in.—Rail
1 pc. ¾ x 5 x 13 in.—Shelf
4 pcs. ¾ x 2 x 33¼ in.—Corner posts
4 pcs. ¾ x 1¼ x 33¼ in.—Corner posts
4 pcs. ⅜ x 5 x 8 in.—Recess ends
4 pcs. ⅜ x 5 x 26 in.—Recess top and bottom
2 pcs. ¼ x 8¾ x 26 in.—Recess back
1 pc. ¼ x 15¾ x 33⅞ in.—Front panel
2 pcs. ¼ x 31⅞ x 33⅞ in.—Side panels
Note: Material for front recess is not listed




TOP
PANEL IS SET BACK 1/8" AT FRONT & TOP
OPEN
NOT MORE THAN 12"
PLYWOOD
PLYWOOD 1/4" X 15 3/4" X 33 7/8"
RECESS AT END TO BE MADE TO FIT YOUR RADIO, ELECTRICAL CONNECTIONS FOR RADIO SHOULD BE CARRIED INSIDE THE CABINET
TOP EXTENDS OVER FRAME AT BACK 1/8"
TOP 3/4" X 16" X 32"
30 1/2"
1 1/4" #10 SCREW
3/4" X 2" X 29"
BACK 1/4" X 8 3/4" X 26"
OPEN
3/8" X 5" X 26"
8 3/4"
3/4" X 2" X 13 1/4"
13"
33 1/4"
16"
3/4" X 5" X 13"
3/4" X 2" X 16"
3/4" X 2" X 14 1/2"
12"
8"
1 1/2"
4"
25 1/4"
2 5/8"
3/4" X 2" X 22 1/4"
PANEL EXTENDS PAST FRAME 1 1/2" AT BACK TO PROVIDE FOR BASEBOARD CUT-OUT
PANEL 1/4" X 31 3/8" X 33 7/8"
NOTCH AROUND BASEBOARD
MAKE A CARDBOARD PATTERN OF BASEBOARD FOR USE IN CUTTING NOTCH
3/4" X 1 1/4" X 33 1/4"
3/4" X 2" X 33 1/4"
FRONT PANEL OMITTED FOR CLARITY
X - DEPENDS ON RADIO SIZE





HEATING SYSTEM REPAIR

Before starting the automatic gas-heating plant, see that the unit, Fig. 1, is well cleaned and the mechanism has been checked by a competent serviceman

When the oil-fired heating plant is idle during summer months, fuel and electrical supplies are shut off. Service the operating parts before starting, Fig. 2

All heating plants, including modern automatic units, require regular attention to keep them operating efficiently and economically. Minor repair and servicing at the beginning of the season can prevent service interruptions and even breakdowns during the peak heating load of the winter months and also will help to prevent fuel waste and costly repair over longer periods of time.

Gas-fired heating units: Gas-fired systems require very little attention other than annual cleaning and inspection and a periodic check to see that the correct ratio of the air-gas mixture is maintained. Usually expert servicemen from the local utility company will attend to this adjustment for a nominal charge, but keeping a check on certain operating details is up to the individual owner. When starting a gas burner, the pilot light is ignited immediately after the gas has been turned on. (*Caution:* Never allow unburned gas from the pilot to accumulate in the flame chamber before igniting it. If this should happen, shut off the gas to the pilot and open the drafts and inspection door and allow time for the unburned gas to dissipate.) If the pilot burner cannot be reached conveniently with an ordinary match, use a piece of newspaper rolled up tightly to form a lighting torch 8 to 10 in. long, Fig. 1. Water vapor—one of the products of the combustion of gas fuel—unites with other waste products in the flue gases to form an acid which attacks the mortar joints in unlined brick chimneys. Because of this, vitreous-enameled or stainless-steel flue linings should be installed in old chimneys to prevent rapid disintegration.

Some heat can be saved by providing shields behind radiators that are set against outside walls. Such shields, which prevent absorption of heat by the walls and consequent waste, may be of insulating or reflective material, or simply hard-pressed board mounted to form an air space of at least 1 in. between it and the wall. If your radiators are covered with boxes or grilles that allow little circulation, you'll get more heat by removing these barriers. Only those that do not stop the free circulation of air are satisfactory. Also keep dust and lint from accumulating in the open spaces by frequent cleaning, to assure good air circulation. If painted with bronzing, especially aluminum, they produce from 12 to 15 percent less heat than if painted with ordinary oil paint.

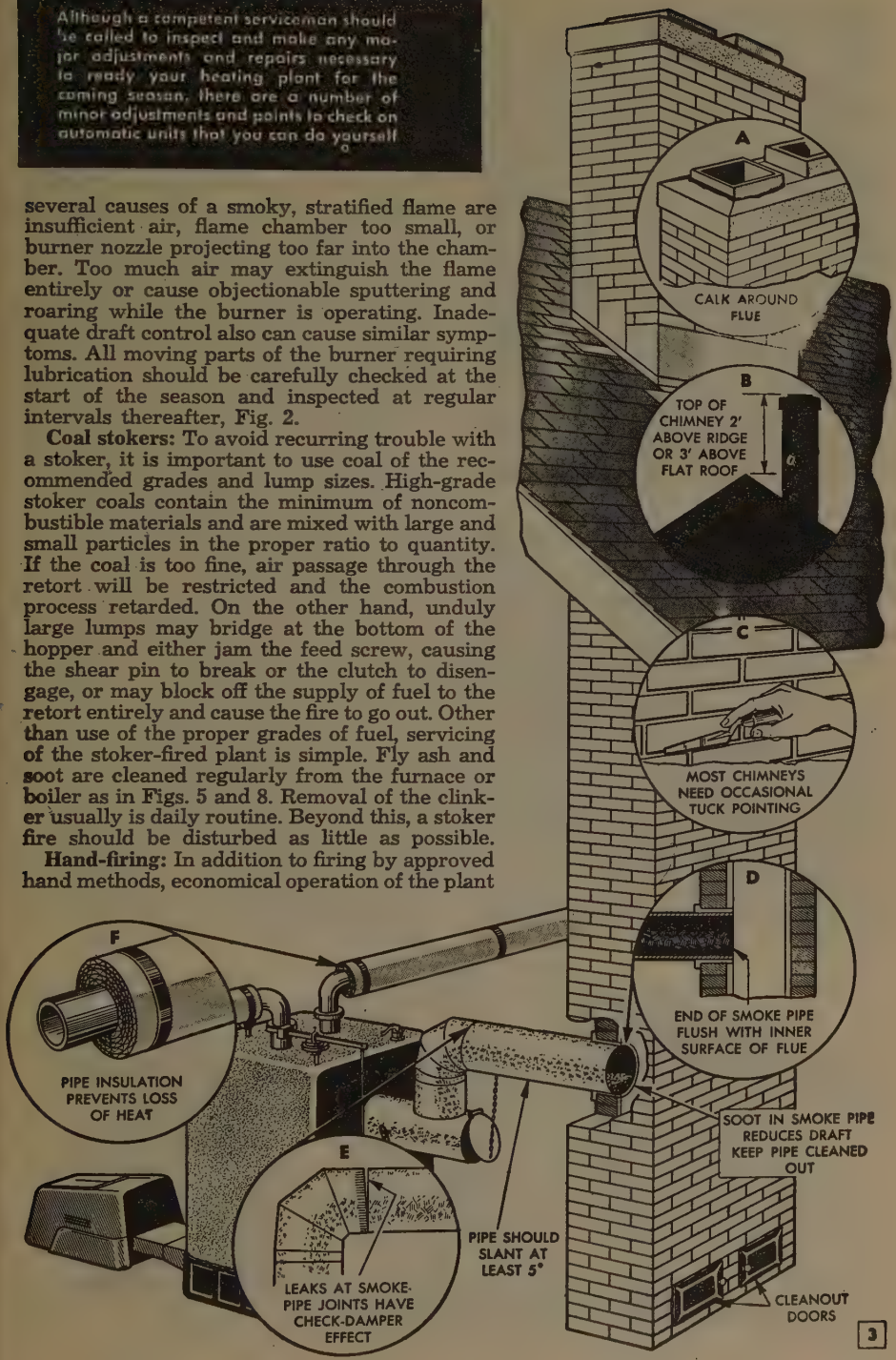
Oil-fired heating units: When the unit is idle during summer months, the fuel and electrical supplies should be shut off. The fuel tank is filled to prevent moisture in the air from condensing in the tank during temperature changes. Water in the oil may interfere with the operation of older-type burners. When the burner is correctly adjusted, the oil-air mixture will burn with a clean, bright flame resulting in a minimum loss in the flue gases and negligible deposits of coke and soot on the walls of the flame chamber and flue. Among the

Although a competent serviceman should be called to inspect and make any major adjustments and repairs necessary to ready your heating plant for the coming season, there are a number of minor adjustments and points to check on automatic units that you can do yourself

several causes of a smoky, stratified flame are insufficient air, flame chamber too small, or burner nozzle projecting too far into the chamber. Too much air may extinguish the flame entirely or cause objectionable sputtering and roaring while the burner is operating. Inadequate draft control also can cause similar symptoms. All moving parts of the burner requiring lubrication should be carefully checked at the start of the season and inspected at regular intervals thereafter, Fig. 2.

Coal stokers: To avoid recurring trouble with a stoker, it is important to use coal of the recommended grades and lump sizes. High-grade stoker coals contain the minimum of noncombustible materials and are mixed with large and small particles in the proper ratio to quantity. If the coal is too fine, air passage through the retort will be restricted and the combustion process retarded. On the other hand, unduly large lumps may bridge at the bottom of the hopper and either jam the feed screw, causing the shear pin to break or the clutch to disengage, or may block off the supply of fuel to the retort entirely and cause the fire to go out. Other than use of the proper grades of fuel, servicing of the stoker-fired plant is simple. Fly ash and soot are cleaned regularly from the furnace or boiler as in Figs. 5 and 8. Removal of the clinker usually is daily routine. Beyond this, a stoker fire should be disturbed as little as possible.

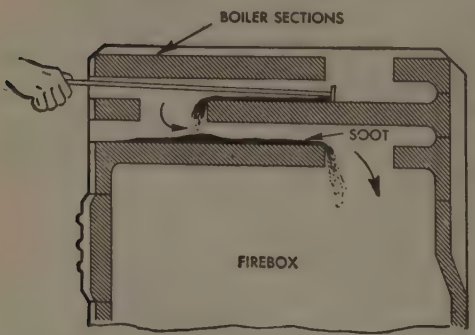
Hand-firing: In addition to firing by approved hand methods, economical operation of the plant


A
CALK AROUND FLUE
B
TOP OF CHIMNEY 2' ABOVE RIDGE OR 3' ABOVE FLAT ROOF
C
MOST CHIMNEYS NEED OCCASIONAL TUCK POINTING
D
END OF SMOKE PIPE FLUSH WITH INNER SURFACE OF FLUE
F
PIPE INSULATION PREVENTS LOSS OF HEAT
E
LEAKS AT SMOKE-PIPE JOINTS HAVE CHECK-DAMPER EFFECT
PIPE SHOULD SLANT AT LEAST 5°
SOOT IN SMOKE PIPE REDUCES DRAFT KEEP PIPE CLEANED OUT
CLEANOUT DOORS

depends on keeping the equipment in serviceable condition. All doors into the furnace either above or below the fire should close tightly. If necessary, tighten up the hinge pins and file or scrape the meeting surfaces of doors and frames to reduce air leaks to the minimum. An excessive air leak around the cleanout door above the fire will act as a partial check, while leakage through the ashpit door or the draft door will make the fire difficult to control. Clean the furnace periodically throughout the heating season to prevent accumulations of ash and soot which act as insulation on heat-transfer surfaces. Check carefully at the end of the season for cracks in the firebox and for warped or cracked grates, Fig. 6.

Smoke pipe: During mild weather, the slow rate of ignition of the lower grades of solid fuels produces considerable soot which coats the inside surfaces of the smoke pipe. As long as the pipe is hot, corrosion of the metal progresses at a very slow rate but, when the fire is allowed to go out in the spring, moisture collects in the pipe and combines with the soot coating to form highly corrosive acids. These acids quickly destroy the effectiveness of ordinary galvanized sheet-metal pipe. If a check shows the smoke pipe to be badly corroded, it should be renewed. Although much more expensive, cast-iron or stainless-steel smoke pipe resists corrosion and will last for 10 years or more. In any case, when installing new pipe be sure that the slip joints are tight and fully joined, Fig. 3, E. Use draw bands on all joints and support the pipe with metal bands or wires attached to the basement ceiling. Smoke pipe should clear woodwork by at least 15 inches.

Chimneys: To avoid draft interference, the chimney should have a separate flue for each heating unit. Unused openings into flues should be bricked up or closed with metal flue stops. Smoke-pipe joints at the chimney are closed with mortar to prevent air leakage. The end of the smoke pipe should come flush with the inside of the flue, Fig. 3, D. Top of the chimney should be at least two feet above the ridge of a peaked roof, Fig. 3, B. Remove tree branches or other obstructions to air movement above or near the chimney. Cleaning the flue can be done with a burlap bag filled with rags, straw or sawdust and a couple of bricks for weight. This "sweeper" is lowered into the chimney by means of a rope or heavy cord and worked up and down to dislodge soot and other loose particles. After cleaning the flue in this manner, remove the accumulation of soot and other debris through the cleanout door. See that the latter closes tightly. In time, mortar joints disintegrate on the part of the chimney which is exposed. Old chimneys re-



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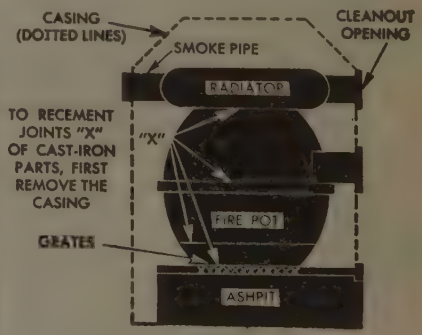


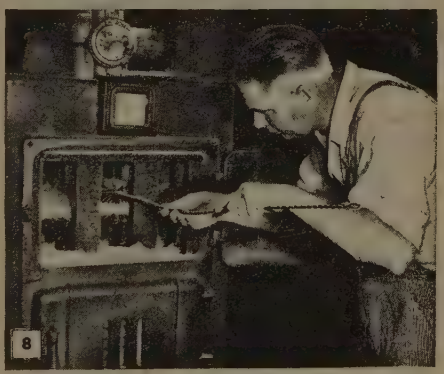
6

quire tuck pointing occasionally to preserve them in serviceable condition, Fig. 3, C. Loose mortar is scraped away and the open joints are soaked with water before pointing with new mortar (1 part cement to 3 parts sharp sand). The joint between the chimney cap and the projecting tile flue, Fig. 3, A, should be made watertight by calking.

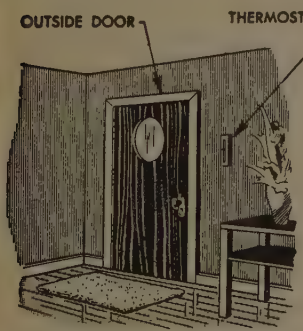
Locating thermostat: The best-quality thermostatic-control units are extremely sensitive to changes in temperature and should never be located near an outside door, window, fireplace, radiator or above a lamp, Fig. 9. The best location is on an inside wall where the unit will be shielded from drafts through hallways, stairways or windows. Blow the dust out of the unit occasionally and remove the outer housing and clean the contact points as directed by the manufacturer. See that the hole where the connecting wire comes through the plaster is plugged tightly. An air leak at this point will affect the operation of the unit, possibly causing it to vary as much as 10 deg. from the true inside temperature. If the heating unit is equipped with an airstat or aquastat, these units should be serviced in much the same manner. Check all electrical connections to see that they are clean and tight.

Warm-air heating systems: Unlike the older gravity warm-air systems, the late-model warm-air furnaces have forced-air circulation. Some forced-air systems bring air in from outside, but most all ordinary installations simply recirculate the air in the house as the normal air exchange in the average home is sufficient for good health. As the air is drawn through the cold-air returns, it passes through one or more filters. The renewable-type filters are replaced at least once during the average heating season. The replaceable filter should be renewed when light cannot be

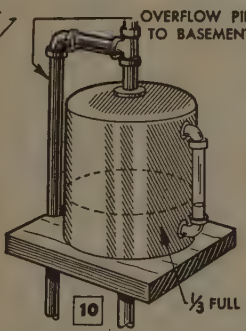
Corrugated insulation on warm-air ducts stops any heat loss to the basement. Seal joints in the covering with gummed paper or cloth tape applied tightly



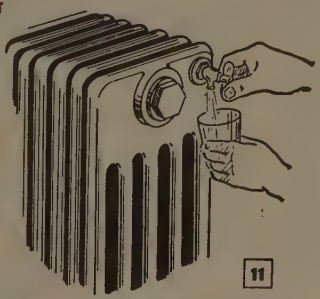
Heat-transfer surfaces of hand or stoker-fired boilers must be kept free from soot and fly ash. Use a wire flue brush having a flexible handle like that shown



9 THERMOSTAT SHOULD NOT BE NEAR OUTSIDE DOOR, WINDOW, FIREPLACE, RADIATOR, ETC.



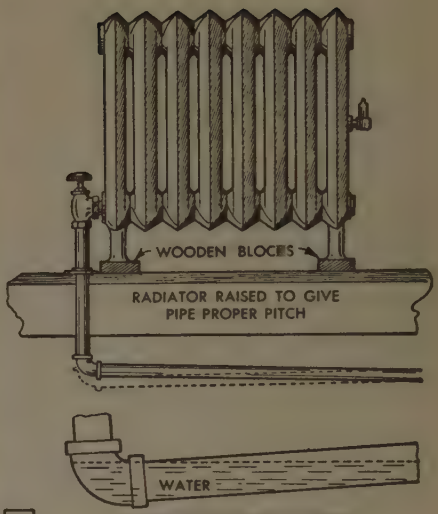
CHECK THE WATER HEIGHT IN EXPANSION TANK OF OPEN HOT-WATER SYSTEM WITH THE ALTITUDE GAUGE



FOR EFFICIENT OPERATION OF A HOT-WATER SYSTEM, AIR IN RADIATORS MUST BE RELEASED

12

Older-type boilers should be covered with a 1-in. layer of asbestos cement which will reduce loss of heat



13

WATER POCKET IN STEAM PIPE

Use blocks to raise a steam radiator and restore the drainage pitch of pipe lowered by settling of house

seen through it, Fig. 4. Joints in cast-iron furnaces, Fig. 6, should be recemented after three to five years of use. It's a simple job to remove the sheet-metal casing and lift off the separate sections down to the ashpit. Clean out all the old cement and brush dirt and loose particles out of the joints before recementing. Be sure to relocate the parts in exactly the same position. A chalk mark across each of the joints makes this easy. Excess cement forced from the joints as the parts are replaced is wiped off and the joint is smoothed with a brush or cloth. To prevent heat loss, cover warm-air ducts with corrugated asbestos paper as in Fig. 7, using gummed paper or cloth tape to seal the joints.

Hot-water systems: Do not flush a hot-water heating unit unless this is necessary in making repairs or when cleaning sediment out of the boiler. "Stale" water contains the minimum of oxygen and lime and will cause less corrosion of metal parts than fresh water. Before starting the season with a hot-water system having an open expansion tank, Fig. 10, check the water level with the altitude gauge to see that the system is full. On the dial-type gauge, the red arrow is set to the required water height and water is added until the black arrow is brought to the same height as the red arrow. On a closed-type system, the water level is maintained automatically and forced-circulation systems have automatically controlled circulating pumps. Air entrapped in the hot-water system impedes water circulation. Pressure is relieved by bleeding the entire system at the radiator valves as in Fig. 11. Bleeding off the air will lower the water level. Check and add fresh water if necessary. Then bleed the system again after a week or so to remove any air carried into it with the fresh water which was added.

Steam-heating systems: In the newer one-pipe steam system, a single pipe conducts live steam to each radiator and returns condensate to the boiler. When the radiators of the one-pipe system fail to heat, the cause usually is faulty air valves. Lime deposits and corrosion cause sticking of the moving parts, preventing air from escaping and steam from entering the radiator. Sometimes the faulty valves can be repaired but, as a rule, it will pay to replace them. Pounding or hammering in a one-pipe steam system usually is caused by water trapped in the radiators or somewhere in the return pipes. Settling of buildings often lowers a pipe below the correct drainage pitch and water collects in the low end beneath the radiator. Hammering is caused by steam being forced through the water in intermittent spurts. The simplest remedy is to raise the radiator on small wooden blocks as in Fig. 13. Hammering also is caused by water collecting in a steam valve that is only partly opened. Be sure the steam valves are either fully opened or closed at all times. Sediment

collects in both hot-water and steam boilers after years of use and is removed by draining and flushing the system with clean water. Never drain the boiler when it is fired. If an emergency repair makes drainage necessary, draw the fire and wait until the system has cooled to room temperature before draining and refilling. Small quantities of water can be added while the system is in operation should it be necessary to replenish the water supply, but the fire should be low and the water added slowly to avoid a sudden temperature change which might crack the boiler castings.

Vapor-vacuum systems: This type of heating plant is practically trouble-free unless air leaks develop. These can occur at the radiator and boiler valves, at the water gauge and the diaphragm joint of the damper regulator and, more rarely, at pipe connections. Operation of the system is controlled by a vacuum valve on each radiator which is actuated by steam pressure. When the pressure drops, the valve closes and prevents air from entering the radiator. Leaks in the vacuum system generally are easy to locate when the boiler is carrying a full head of steam. The method of repair will depend on the location and nature of the leak. Liquid compounds are available which are effective in sealing small leaks in both steam and vacuum-heating systems. Of course, excessive leaks at the water gauge, around valves, at the damper regulator, or in a pipe joint are permanently repaired only by replacement of the defective parts.

Insulating pipes and boilers: Long runs of both hot-water and steam pipes should be insulated to prevent heat loss with a ready-formed insulating covering as in Fig. 3, F. Asbestos cement is applied to the pipe fittings and valves. Late-model boiler units are provided with insulation, but older boilers should be coated with asbestos cement to reduce heat loss to the basement. A 100-lb. bag of this special cement will cover the average boiler of either the square or round type. Mix the cement with water to form a thick paste and trowel it on the boiler to a thickness of about one half inch. Cover this first coating with 1-in. wire mesh, as in Fig. 12, and then apply another ½-in. layer to cover the wire. Smooth the job with a wet sponge and cover with muslin or cheesecloth pressed onto the cement while it is still wet.

Radiators: As a rule, it is not advisable to cover older-type radiators in any way, as coverings tend to retard air circulation. Nor is it advisable to coat old radiators with bronzing paints, as the metallic pigments in these paints tend to overlap on drying and form a reflecting surface which retards heat transfer.

The photo in the upper-left corner shows a living-room radiator before it was covered. The upper-right photo shows the same radiator covered with pressed board bent to shape and lined with insulating board. The cover improves the appearance of the room without interfering with the output of heat. Reinforcements at the ends increase the strength of the cabinet. Perforations are drilled in the top to increase the circulation of air. Sheet metal could have been used instead of wood in this case. With the addition of the cover, the radiator will also act as a convector, due to the fact that the front and sides are partly covered. Although the height, width and depth of radiator sections are standardized, the number of sections in each unit varies and, for that reason, no dimensions are given. For appearance, the cover should extend beyond the valve, vent and trap. All units are finished with two coats of a high-gloss enamel.

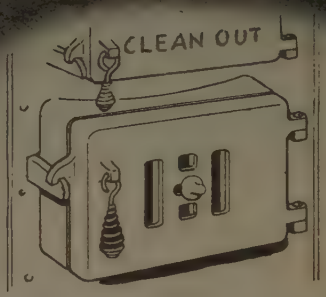
10 FIRING HINTS TO SAVE COAL

Coal, when properly fired, provides greater heat value per dollar than any other fuel. But it is estimated that 10 percent of the coal used to heat the average house is wasted through improper hand-firing and furnace regulation. While there are many factors to consider in arriving at the correct method in each case, these 10 hints on how not to fire will reduce waste, minimize smoke and lessen furnace attention.

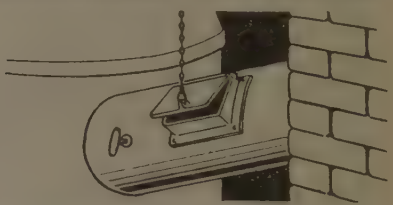
In case the simple measures illustrated and described here are not enough to effect a substantial saving of fuel and the living quarters are not fully comfortable, you may have to shut off heat to quarters where it is not required, such as an attached garage or a storeroom, precautions being taken to prevent freezing of water in pipes and

DON'T BANK THE FIRE BED with ashes. This only tends to produce clinkers which cause inefficient burning and waste of coal. It is better to keep a deep fuel bed and to regulate the fire with the controls

DON'T LET ASHES ACCUMULATE in the ashpit. Make it a practice to remove them each morning after shaking down the fire. A clean ashpit assures proper combustion and prolongs the life of the furnace grates



DON'T NEGLECT TO CLOSE FIRE DOOR after firing. Leaving it open cools fire and wastes fuel. Keep the slide open in the fire door. Air through opening aids combustion in most heating plants



DON'T FORGET THE CHECK DAMPER if the furnace is not equipped with a thermostat. Open it when you want less heat, close it when you want more

DON'T RAM THE POKER INTO THE GRATES. Ashes mixed with fire cause clinkers. Bend poker as indicated and use sparingly to break up top crust

radiators. Even bedrooms may have to be closed during the day and heat turned on only a few hours in the evening to eliminate the chill, to direct most of the heat to the living quarters during the day. Many basements are much warmer than necessary and much of the heat can be directed to the living quarters by insulating the steam or hot-water pipes and covering a boiler with a 2-in. layer of shredded muslin. Excess heat in a basement where a hot-air furnace is located can be directed into the rooms above by installing registers. Although much basement heat is transmitted to the rooms above through the floor, absorption of heat by basement walls and floor represents a loss. Firing a boiler or furnace by hand economically is not just a matter of following a set of rules, but adapting a technique of firing your particular fur-

DON'T REGULATE FIRE BY ASHPIT DOOR itself; use the draft damper in front. Operate this and check damper simultaneously. When you want more heat, open draft damper and close the check

DON'T LET HEAT ESCAPE up the chimney. Use the turn damper to control chimney draft by keeping damper as nearly closed as possible without smoke emerging from the fire door. This operation is important

DON'T SHAKE GRATES AT NIGHT unless deep ash bed takes room needed for fresh coal. Shake gently and stop when red glow appears in ashpit. Shaking every other day should be often enough in mild weather

DON'T SHAKE LIVE COALS INTO ASHPIT. Keeping grates covered with thin ash layer in the cold weather helps hold fire, keeps it burning evenly

DON'T LET SOOT ACCUMULATE. Make it a habit to throw rock salt on a hot fire periodically to keep the furnace and the smoke pipe free of soot

nace with your particular brand of fuel.

Save fuel by calking: In most houses, slight settling of foundations and shrinkage of materials cause cracks around doors and windows. Sometimes there will be cracks in mortar joints of masonry or stucco walls. As such cracks are heat wasters and wall cracks in masonry may weaken the structure, all of them should be made wind and weatherproof as soon as they are noticed.

Cracks around doors and windows can be sealed best with calking compound, a material elastic enough to compensate for the movements of settling. It sticks tightly to all materials, becomes dry on the surface but remains semi-plastic underneath, and is water and weatherproof. It can be bought in several colors and in two consistencies—a soft grade that can be pressed through a calking gun and a heavier grade that can be applied with a knife.

Application of calking compound is done most easily with a gun which pushes a ribbon of material into the cracks. Used in this way, the compound must be free from skins and lumps which might clog the nozzle. Around hinges and in some corners, it may be necessary to force down the compound and smooth it with a wooden paddle about ½ in. wide, which has been soaked in oil to prevent the compound from adhering to the wood.

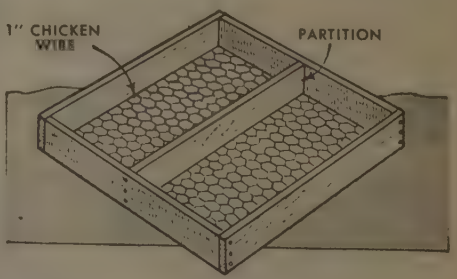
Before filling cracks, see that they are dry, and clean out all loose dirt, mortar and paint scales. Metal framework should be scraped or wire-brushed to remove rust, and given a coat of paint before calking. Wide cracks should be painted before applying the compound, but if they are more than ¼ in. wide they should be filled with oakum forced in with a blunt chisel, putty knife or calking iron and packed down by tapping the iron with a hammer until the filling comes up to ¼ in. of the surface. Cracks in masonry or stucco should be filled with cement mortar consisting of portland cement, 1 part, hydrated line, 1 part, and clean sand, 2 or 3 parts. Wet the cracks before filling with cement, using a small putty knife or tuck-pointer's trowel When the cement is dry, cover it with a ribbon of calking compound to keep out the water.

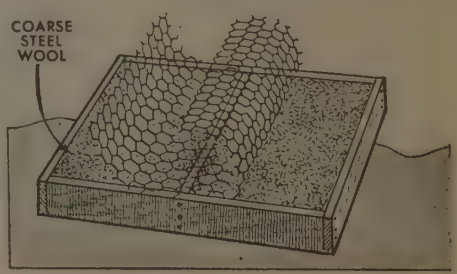
Identifying heating-system valves: In case a leak develops or some other emergency occurs in a hot-water heating system, it may save considerable expense if any member of the household is able to manipulate the valves to correct or minimize the trouble. Instead of trusting to memory, attach tags, which give clear and complete information, to the various controls. Arrows can be used to indicate the direction of turn to open or close the valves. The functions of the controls can be described sufficiently

and accurately in a few words.

Filter for furnace: A replacement filter for the warm-air furnace can be made easily. It is inexpensive, cleans easily and will last indefinitely. It consists of a wooden frame 2 in. deep, having the same overall dimensions as the original filter. A wooden partition nailed across the frame divides the filter into two sections to simplify cleaning. Each section is packed with one pound of coarse steel wool which is held in place by tucking 1-in.-mesh poultry wire over both sides of the frame. To clean the filter, simply remove the steel wool and wash it in kerosene, allowing it to dry before replacing.

The efficiency and wear of the filter can be greatly increased by sprinkling a small amount of lightweight motor oil over the steel wool after cleaning. Check the filter frequently for any accumulation of dirt.



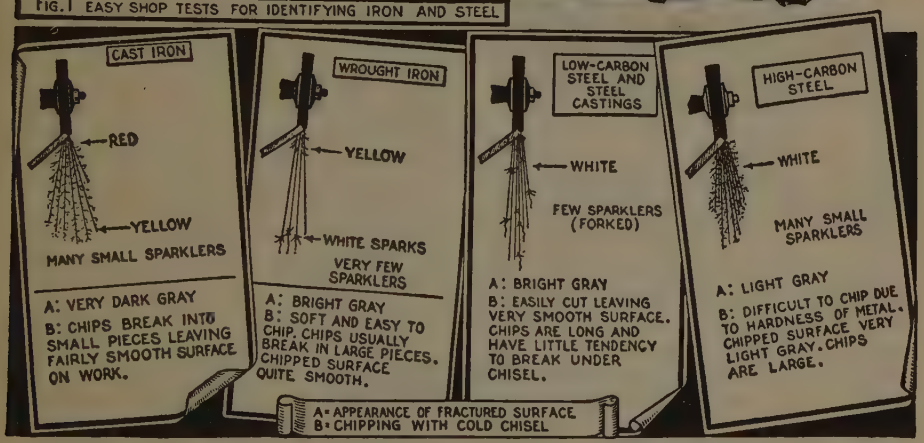


HEAT-TREATING METAL

THE natural properties of metals can be so greatly modified by simply heating and cooling under proper conditions that the success of many shop jobs is determined almost entirely by how well this part of the work is done. Heat treating of iron and steel to produce hardness, softness, springiness, toughness and the other properties required for construction purposes is not difficult if a few simple rules are followed.

Fig. 1 shows tests which may be used to classify iron and steel. The first and most conclusive test is made by lightly touching the metal to a power-driven grinder, and noting the quantity, color and form of the sparks emitted. All grades of iron and plain carbon steel have two things in

FIG. 1 EASY SHOP TESTS FOR IDENTIFYING IRON AND STEEL


CAST IRON
RED
YELLOW
MANY SMALL SPARKLERS
A: VERY DARK GRAY
B: CHIPS BREAK INTO SMALL PIECES LEAVING FAIRLY SMOOTH SURFACE ON WORK.
WROUGHT IRON
YELLOW
WHITE SPARKS
VERY FEW SPARKLERS
A: BRIGHT GRAY
B: SOFT AND EASY TO CHIP. CHIPS USUALLY BREAK IN LARGE PIECES. CHIPPED SURFACE QUITE SMOOTH.
LOW-CARBON STEEL AND STEEL CASTINGS
WHITE
FEW SPARKLERS (FORKED)
A: BRIGHT GRAY
B: EASILY CUT LEAVING VERY SMOOTH SURFACE. CHIPS ARE LONG AND HAVE LITTLE TENDENCY TO BREAK UNDER CHISEL.
HIGH-CARBON STEEL
WHITE
MANY SMALL SPARKLERS
A: LIGHT GRAY
B: DIFFICULT TO CHIP DUE TO HARDNESS OF METAL. CHIPPED SURFACE VERY LIGHT GRAY. CHIPS ARE LARGE.
A = APPEARANCE OF FRACTURED SURFACE
B = CHIPPING WITH COLD CHISEL

common; they contain iron and carbon. Ordinary cast iron contains the most carbon, wrought iron the least, and steels intermediate amounts.

Iron castings, too hard for machining may be annealed by slowly heating them until red in a forge and cooling slowly while buried in ashes, lime or mica powder. A large box filled with well dried slaked lime or fine mica powder is handy for this purpose. If the work is well surrounded with lime or mica a day or more will be required for cooling. The slower the cooling process is, the softer and more workable will be the metal. Cast iron can be made somewhat harder and consider-

Cast iron can be made harder and more resistant to wear by heating to bright red and quenching in water
AT CRITICAL POINT MAGNET CEASES TO ATTRACT
MAGNET
STEEL BEING HEATED

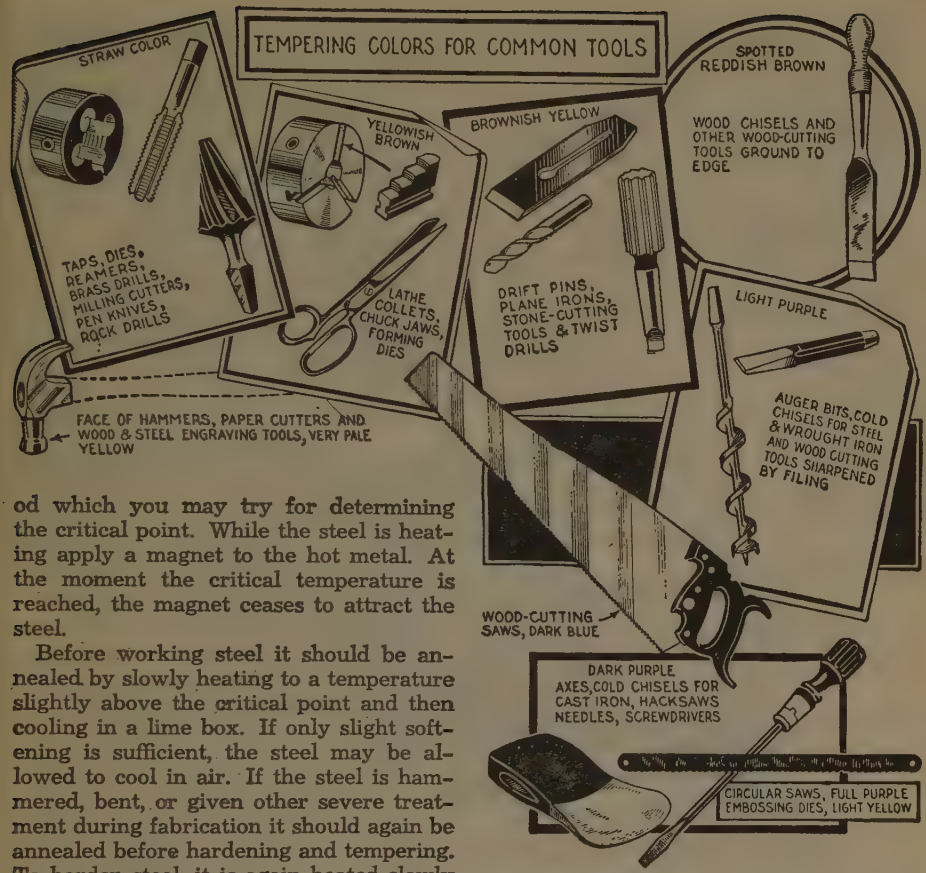
FIG. 2, COLORS PRODUCED DURING HEATING OF STEEL

Color	Temperature
Very Pale Yellow	430° F.
Light Yellow	440
Pale Straw Yellow	450
Straw Yellow	460
Deep Straw Yellow	470
Dark Yellow	480
Yellowish Brown	490
Brownish Yellow	500
Spotted Reddish Brown	510
Purplish Brown	520
Light Purple	530
Full Purple	540
Dark Purple	550
Full Blue	560
Dark Blue	570
Pale Blue	600
Bluish Green	630
Bright Red (in dark)	725
Red (in ordinary room light)	885
Red (in full daylight)	1077

Note—Colors at different temperatures depend upon the amount of light in the room

ably more resistant to wear by heating it to a bright red color and immediately plunging into, or quenching, in water. The water is best kept in a large tub beside the forge. It is important that the quantity be large so that it will not become hot too quickly. Wrought iron is much used in the forging of architectural ornaments and fixtures and it is easy to weld. After hammering and shaping wrought iron, it should be annealed by heating to a dull red color and cooling in air. Annealing relieves the strains set up in the metal by the hammer and renders it less likely to fail in use.

Different grades of steel contain varying amounts of carbon; those containing the larger amounts are called high-carbon or tool steel. Low-carbon steel is frequently termed mild steel. By observing the nature of the sparks produced when grinding, the approximate hardness of steel and hence its suitability for different purposes may be determined. Although every grade of steel has a definite temperature above which it must be heated for annealing and hardening, it is not difficult to tell when this temperature has been reached after performing the following experiment. Place a piece of steel over a lighted gas burner and watch the metal as it slowly heats. At first the metal will steadily change from its original color to a faint yellow, straw color, purple, blue, etc., until at a certain temperature it will apparently stop heating although still remaining in the fire and retaining a certain color for an appreciable time, after which it will again start to change colors and thus appear to heat faster until white heat is reached. The temperature at which the steel momentarily ceases to get hotter, indicated by the lack of color change, is the temperature at which the molecules are rearranging themselves, and at this temperature, known as the critical point, the steel is actually absorbing heat without getting hotter. There is still another meth-

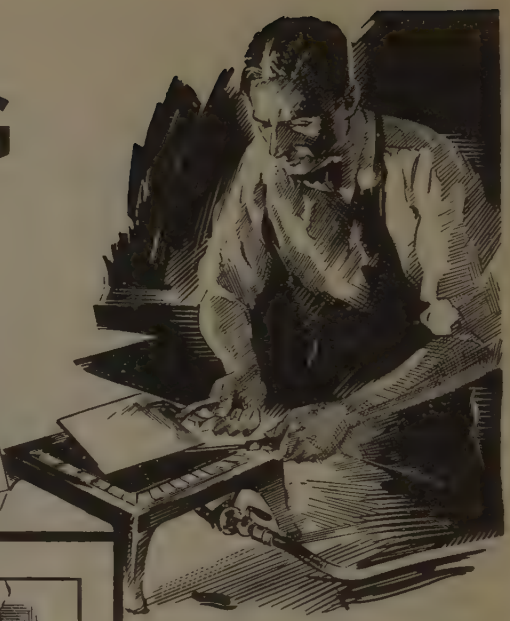

TEMPERING COLORS FOR COMMON TOOLS
STRAW COLOR
TAPS, DIES, REAMERS, BRASS DRILLS, MILLING CUTTERS, PEN KNIVES, ROCK DRILLS
YELLOWISH BROWN
LATHE COLLETS, CHUCK JAWS, FORMING DIES
BROWNISH YELLOW
DRIFT PINS, PLANE IRONS, STONE-CUTTING TOOLS & TWIST DRILLS
SPOTTED REDDISH BROWN
WOOD CHISELS AND OTHER WOOD-CUTTING TOOLS GROUND TO EDGE
LIGHT PURPLE
AUGER BITS, COLD CHISELS FOR STEEL & WROUGHT IRON AND WOOD CUTTING TOOLS SHARPENED BY FILING
FACE OF HAMMERS, PAPER CUTTERS AND WOOD & STEEL ENGRAVING TOOLS, VERY PALE YELLOW
WOOD-CUTTING SAWS, DARK BLUE
DARK PURPLE
AXES, COLD CHISELS FOR CAST IRON, HACKSAWS NEEDLES, SCREWDRIVERS
CIRCULAR SAWS, FULL PURPLE
EMBOSSING DIES, LIGHT YELLOW

od which you may try for determining the critical point. While the steel is heating apply a magnet to the hot metal. At the moment the critical temperature is reached, the magnet ceases to attract the steel.

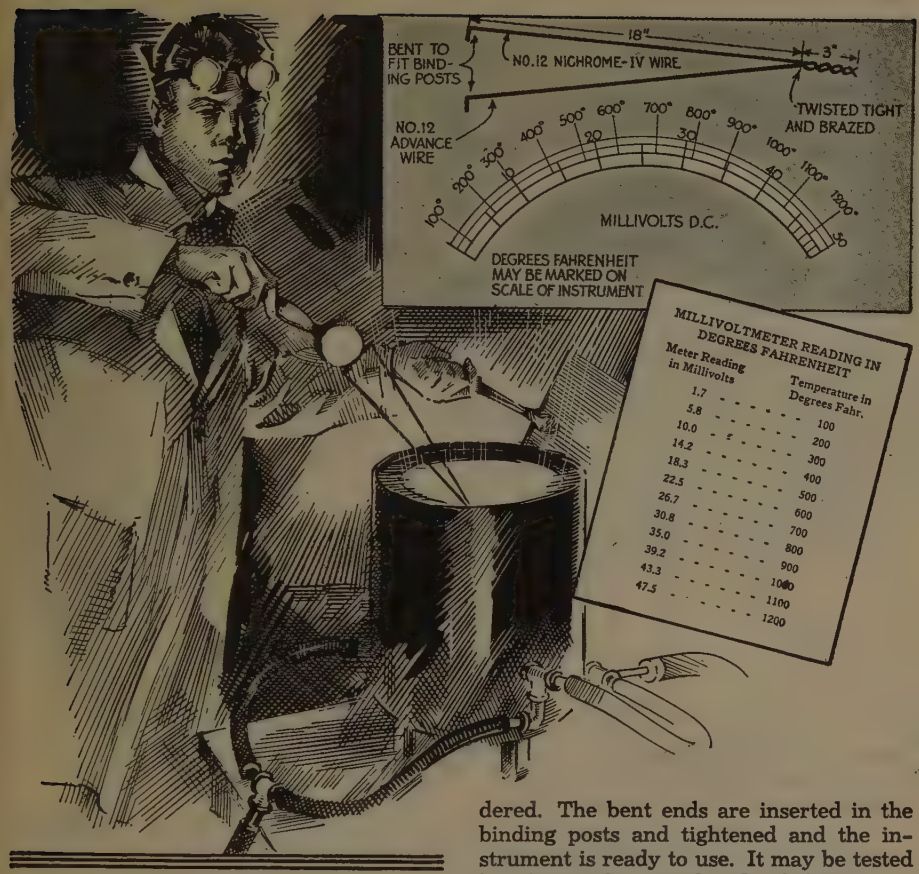
Before working steel it should be annealed by slowly heating to a temperature slightly above the critical point and then cooling in a lime box. If only slight softening is sufficient, the steel may be allowed to cool in air. If the steel is hammered, bent, or given other severe treatment during fabrication it should again be annealed before hardening and tempering. To harden steel, it is again heated slowly and evenly to a temperature just above the critical point and plunged into water. If only a part of the tool or metal is to be hardened this portion only is submerged. The steel is left in the water until it ceases to hiss, after which it may be allowed to finish cooling in the air, or in an oil bath. Hardened steel is too brittle for most purposes, therefore tools must be tempered after hardening to give them toughness. Tempering is really a process of partly softening the metal. Too much softening, however, often defeats the purpose of hardening. Steel is tempered by heating it to a low temperature and allowing it to cool in air. For most purposes a small surface of the metal may be polished until bright before heating, so that the proper temperature may be determined by the color changes during heating. A chart of colors at different temperatures is given in Fig. 2. The work may be heated in a forge over a gas flame or in sand.

HEAT-TREATING METAL

Brass, copper and aluminum made hard and brittle by hammering, bending and other shop operations, are restored to their former softness by annealing

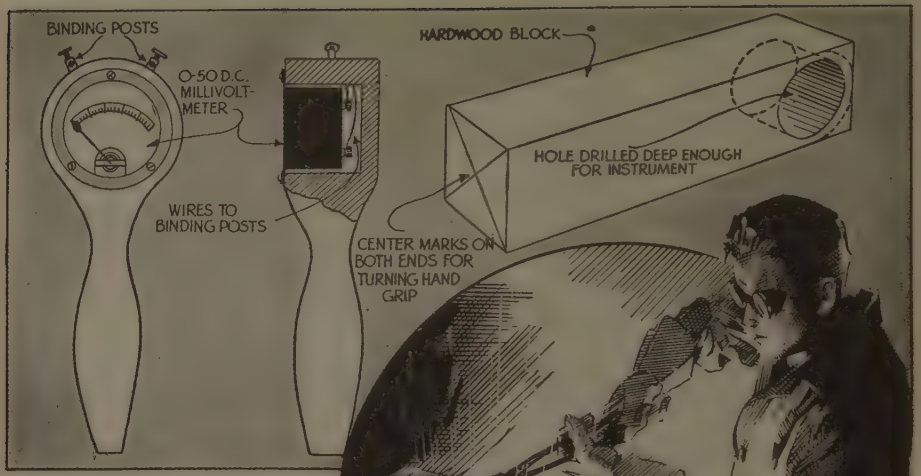


METALS such as brass, copper and aluminum frequently become hard and brittle, either due to hammering or other severe shop operations, and unless they are properly annealed or softened, they will break or tear and spoil a good job. All of these metals and most of the common alloys except aluminum and its alloys can be softened to some extent by simply heating them and either allowing them to cool in the air or plunging them into cold water; however, there are a few tricks which make this work a lot simpler and more effective. With some metals like aluminum and aluminum alloys, annealing by simply heating in an open flame is not satisfactory because of the action of the fuel on the metal and also because of the danger of overheating and spoiling the job entirely. Where tarnish formed during the heating will cause no trouble, copper and brass may be softened sufficiently for most purposes by heating them to a dull red heat and either cooling in air or plunging into cold water. The metal should be heated in a furnace or on a hot plate so that all parts are equally heated. A better plan, if convenient, is to heat the work in a simple furnace. An outfit of this type is quickly assembled by building a shield of brick or asbestos board around a gas hot plate. A sheet of steel placed over the burner prevents the flame from coming in direct contact with the work. Although the simple procedure just described is adequate for ordinary purposes, it is better practice to heat brass and copper as well as aluminum in a furnace as free as possible from gases. It is also equally important that the temperature to which these metals are heated be rather accurately controlled. The easiest method of heating to get these results is by placing the work in a closed metal container such as a thick-walled iron pot fitted with a lid and to place this in a furnace such as described in "Little Library" booklet No. 36. To prevent overheating, some method of meas-



uring the temperature inside the iron pot is essential. The easiest plan is to place a piece of brightly polished steel in the pot and judge the temperature by its color. A dark blue color indicates a temperature of about 570° F. Red indicates 725° F. and a bright red which is almost white indicates a temperature of 1200° F. or more.

At a cost of only a few dollars anyone can make a simple thermocouple pyrometer which will take the guesswork out of heat treating. All that is needed is an inexpensive d.c. millivoltmeter (0 to 50 millivolts), 21 in. each of Nichrome IV and Advance resistance wire and two binding posts. Dimensions for the handle will depend upon the size of the meter. The binding posts are connected to the meter posts inside the case. Heavy wires should be used for this and they should be well soldered. The bent ends are inserted in the binding posts and tightened and the instrument is ready to use. It may be tested by placing the joined ends of the wire in the flame of a burner for a few minutes. If the meter needle moves in the wrong direction simply interchange the wires at the binding posts. One of the drawings shows a millivoltmeter scale marked with temperatures at approximately the proper points. The glass cover may be removed and the values marked on the scale, or millivolt readings may be taken and converted into temperature by glancing at the table. The figures given are average values and will be found close enough for many purposes. However, if more accuracy is desired the instrument should be calibrated by placing the couple in molten tin and allowing the metal to cool slowly. As cooling progresses the meter reading will slowly drop until the metal starts to solidify. At this point the needle will remain stationary until all of the tin has so-


BINDING POSTS
0-50 D.C. MILLIVOLT-METER
WIRES TO BINDING POSTS
HARDWOOD BLOCK
HOLE DRILLED DEEP ENOUGH FOR INSTRUMENT
CENTER MARKS ON BOTH ENDS FOR TURNING HAND GRIP

SOLIDIFYING TEMPERATURES OF METALS USEFUL FOR TESTING PYROMETER

Metal	Degrees Fahr.
Tin	449
Lead	621
Zinc	787
Aluminum	1220

lidified, after which it will again continue to move toward zero. The point at which the needle remained stationary during the solidification of the metal should be recorded as it indicates a temperature of 449° F. Other accurate temperatures may be located on the pyrometer by performing a similar test with other metals, solidifying temperatures of which are given in a table. These points may be marked on the instrument scale and intermediate temperatures found by dividing up the space between them.

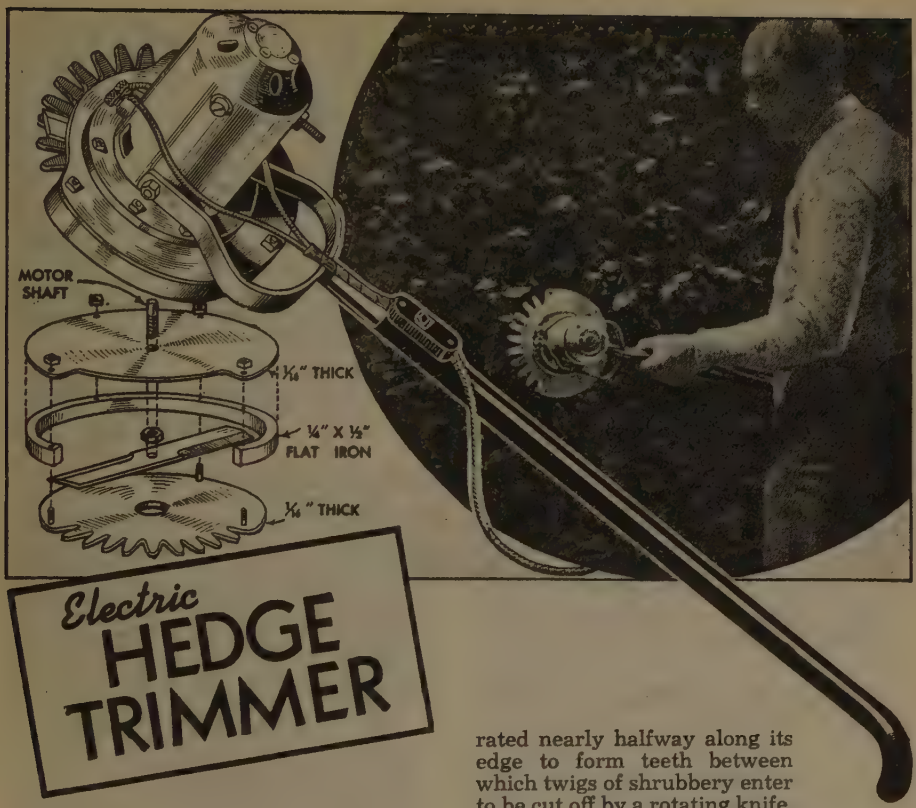
Aluminum is annealed by heating it in a closed container placed in a furnace or oven to a temperature of 650° F. The work is slowly heated until all parts have had time to get to this temperature. The thermocouple may be inserted into the heating pot from time to time and as soon as the temperature reaches 650° F., the burners should be cut down to hold this value until all parts are heated. Some care is required in controlling the furnace to prevent overheating. The common aluminum alloys are treated in the same manner. For the best results with brass, follow the same methods as described for aluminum except that the temperature should not exceed 1112° F. for ordinary grades. Copper may be similarly annealed at 1202° F.

Inserting Hectograph Ribbon Without Soiling Hands

It is not necessary to soil the hands when inserting a hectograph ribbon in the typewriter. Just fasten a leader of ordinary ribbon to the end of the hectograph ribbon using cellulose tape, and thread the leader in the machine.

Renewing Surface of Hectograph

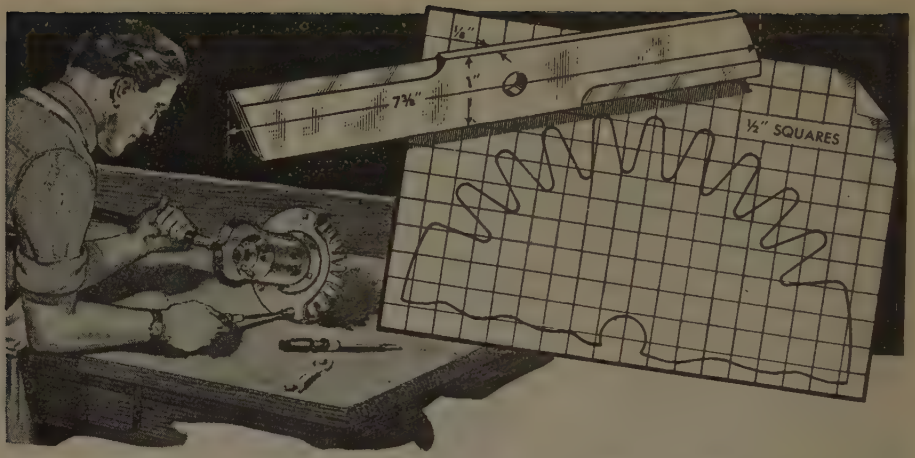
After a hectograph has been used for a length of time, the gelatinous compound becomes pitted and uneven. Melting the compound is not always successful as bubbles may develop in the solution. One way to resurface the composition is to pour alcohol over it and then burn the liquid off. After it has hardened again, the hectograph is ready for use.



Electric HEDGE TRIMMER

IMPROVISED from an old vacuum cleaner, this electric hedge trimmer is fast, efficient and easy to handle. Also, it can be used not only on privets and similar shrubbery, but on weed patches and in other places that cannot easily be clipped by a lawn mower. To convert a vacuum cleaner into a hedge trimmer of this kind, first remove the sweeper housing, including the suction fan. The assembly usually can be taken off merely by removing a few bolts that secure it to the motor housing. Next, substitute a new housing as shown in the illustration. This consists of top and bottom plates, with a flat metal segment between them which forms the side. On the trimmer shown in the illustration, sheet aluminum was used for the plates and spacer in order to assure light weight. However, 1/16-in. sheet iron or other similar material can be used for the plates, but the spacer must be of heavier stock so that it can be drilled for bolts, which hold it in place between the plates. Over-all sizes of the plates are not given as they are determined by the particular type of vacuum cleaner you use. The lower plate is serrated nearly halfway along its edge to form teeth between which twigs of shrubbery enter to be cut off by a rotating knife. The width and depth of the teeth and the slots are given in the cross-hatched pattern.

For the knife, you can grind down an old file of suitable size. Dimensions of the knife shown are correct only when the bottom plate is the size given in the pattern. For a plate of a different size, the length of the knife must be varied accordingly, although its thickness need not exceed ⅛ in. In general, the knife should be long enough to extend to within about ⅛ in. of the tip of the teeth, and the center hole should fit the motor shaft snugly. To drill a hole in a file, it is necessary first to remove the temper. This is done by heating the file to a dull red and then allowing it to cool gradually. After removing the temper and drilling the hole, the file should be ground to a knife edge on opposite sides as shown, so that the cutting edge is toward the bottom plate, taking into consideration the direction in which the blade will move on the motor shaft. Also, it is important to balance the knife to avoid vibration. When the knife is completed, it should be heated to a cherry red and quenched in oil or water to harden it. Two nuts hold the knife



on the shaft, one above and one below. A large hole should be drilled in the bottom plate for inserting a socket wrench so that the lower nut can be tightened whenever needed to prevent the knife from slipping.

The original vacuum-cleaner handle is retained because its length counterbalances the weight of the motor and enables the operator to guide the head without much effort. On some types of vacuum cleaners the switch for the motor is located at the end of the handle. The switch may be left at this location and operated with the right hand; or it may be mounted near the motor, as shown in the illustration.

Shear Guide Helps Trim Hedge To Uniform Height

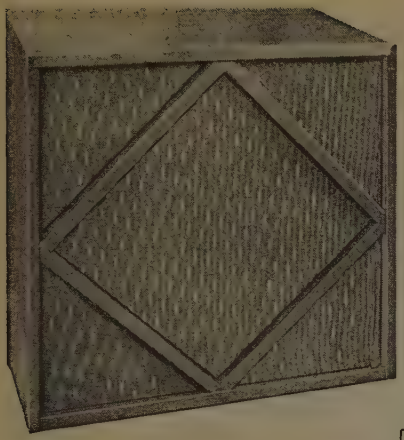
With this simple guide riding on top of the hedge, you will find it easy to keep a hedge trimmed uniformly. Extending metal rods stapled to a trough-shaped board, which straddles the hedge as shown, restrict the depth of the cut.

Hedge-Trimming Guide of Wire Stretched Between Posts

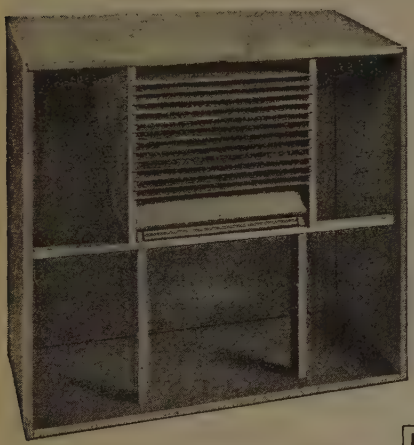
It's no trick to trim hedge uniformly when this simple guide is used

Of the many devices to assist in trimming a hedge uniformly, the one shown is perhaps the simplest. It consists of a length of heavy wire, which is stretched horizontally from steel posts, both wire and posts being left permanently in place as the foliage will conceal them.

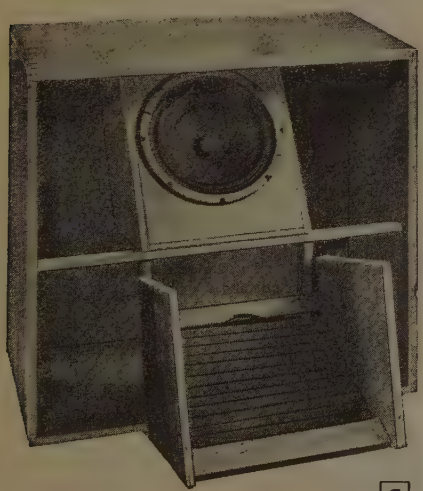
HI-FI SPEAKER ENCLOSURE



A



B



C

THIS FOLDED exponential horn, in a 20-in. cube, has remarkable range of frequency response. Previous exponential horns have pleased the music lover and high-fidelity enthusiast, but they were either too high for use in a living room or, if they were low enough, they lacked high-note response. It is well known that high audio frequencies leave a speaker diaphragm as a narrow beam, and with earlier low speakers the beam was too low to reach the listener's ear.

A simply constructed acoustic prism solves this problem as shown in the accompanying diagrams. The speaker is inclined 30 deg., and the prism also bends the high notes 30 deg., so that you can hear the beam even if you are standing. A good 8-in. PM speaker is small enough to reproduce the high notes of fine music, yet large enough to move air for the bass tones. The bass tones come from the back of the diaphragm, and the exponential horn carries them around so that they emerge from the front of the assembly. Low tones bend readily as they have no beam effect.

Since no absorption is required, or desired, the efficiency is high, and ⅜-in. plywood is adequate for construction. All joints should be carefully glued and nailed. The 8-in. speaker should be an extended-range type with a power-handling ability of about 7 watts. From the 8-in. driver, the horn reproduces low notes as well as 15-in. speakers. Further, the use of a single reproducer eliminates crossover networks and intermodulation distortion. This distortion is present in many two and three-element loudspeaker systems. It is prevented in this design because the horn loads the single diaphragm. You will find that this

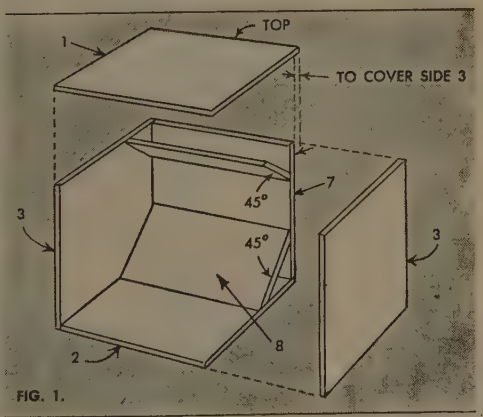


FIG. 1.

speaker-horn combination sounds as loud with 7 electrical watts input, as 28 watts to a speaker equipped with an infinite baffle (a tight box lined with absorbent material). You gain an additional advantage as your amplifier has less distortion at lower power outputs, and less than 7 watts will drive the horn so clearly that you will not have to turn up the gain on your amplifier.

Photos A, B and C show various views of the completed unit. The acoustic prism, which bends the high notes, is a series of parallel and horizontal sheets glued into the sidepieces, ⅜ in. apart. These sheets can be heavy cardboard, plastic or metal. Fig. 1 shows the first step in assembly with the right-hand side and top removed. The speaker panel, housing and braces are detailed in Fig. 2. All dimensions can be easily checked in the material list. Fig. 3 is a cross section through the middle, showing the prism. Note that the back of the speaker housing is open to the horn. Fig. 4 shows the acoustic prism, partly and fully assembled. The front grille detail is quite simple as will be noted in photo A. Either heavy grille cloth or brown flock-coated grille screening may be used. This grille screening is galvanized wire mesh, flocked on both sides. Another grille material now available is Lumite-plastic grille cloth. It requires no backing and is of the wide-mesh basket-weave type.

Operating as an auxiliary speaker, this folded exponential horn can be used with any high-grade receiver or audio amplifier.

MATERIAL LIST

Item	Reqd.	Name	Dimensions — Inches
1	1	Top	20 X 20 X ⅜
2	1	Bottom	20 X 19¼ X ⅜
3	2	Sides	20 X 19⅜ X ⅜
4	1	Speaker Panel	10½ X 8½ X ½; 30°, 30°
5	2	Sides, Speaker Housing	9 X 13 X ⅜ (See Fig. 3)
6	1	Slant Panel	8 X 19¼ X ⅜; 45°, 45°
7	1	Back	19¼ X 19¼ X ⅜
8	1	Slant Panel	12 X 19¼ X ⅜; 45°, 45°
9	1	Bottom Speaker Housing	9¼ X 10 X ⅜
10	1	Brace	1 X 19¼ X ½
11	2	Brace	1 X 9¾ X ¾
12	2	Prism Sides	7 X 9 X ⅜
13	2	Prism Braces	¾ X ¾ X 9¼
14	17	Prism Vanes	Cut to fit prism sides (Item 12)

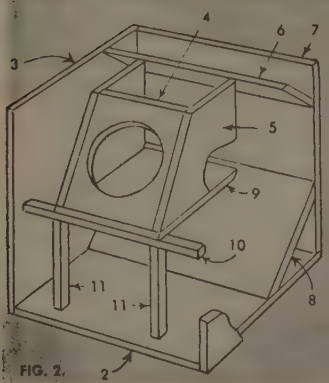


FIG. 2.

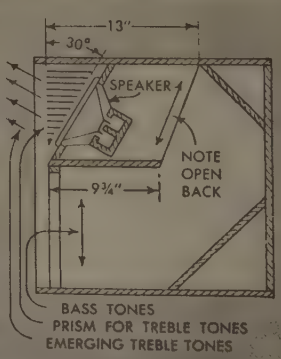


FIG. 3. CROSS SECTION SHOWING PRISM

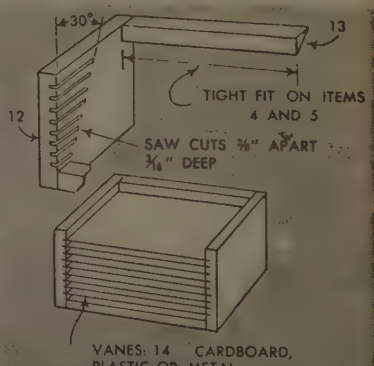
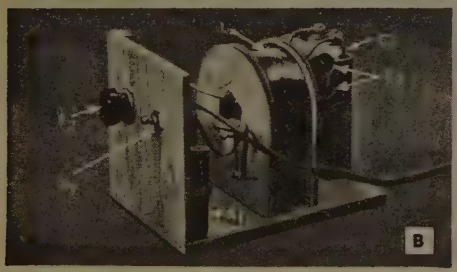


FIG. 4. ACOUSTIC PRISM

HI-FI SPEAKER ENCLOSURE



YOU WILL BE thrilled with the lifelike reproduction of this unit. Following a trend of advanced design for high-fidelity enthusiasts, this two-way folded-horn enclosure will reproduce your records with solid bass and clear treble tones that you probably didn't know were there. If you have a good audio amplifier, this is the loudspeaker to go with it. Extended-range loudspeakers in the proper enclosures do an excellent job, as far as they go, but horns or baffles large enough to go much below 100 cycles per second are usually too large for a living room. It generally is accepted that separate speakers are required to get good reproduction of both bass and treble tones. The low-frequency speaker (woofer) takes the lowest notes and goes on up to a few hundred cycles. The high-frequency speaker (tweeter) takes over at this point and goes on up to 15,000 cycles per second, and a network should be provided to divide the energy between the two types of speakers.

It is important that the amplifier used

MATERIAL LIST

Item	Req'd.	Dimensions, in.	Name
1	2	⅜ X 22¾ X 41	Sides
2	1	⅜ X 5¼ X 14½	Cap No. 1
3	1	⅜ X 5¼ X 14½	Cap No. 2
4	1	⅜ X 14½ X 28⅜	Back No. 1, hole for low-freq. spkr.
5	2	⅜ X 3¼ X 14½	45-deg. corners
6	1	⅜ X 4½ X 28⅜	Brace No. 1
7	1	⅜ X 4½ X 12¼	Brace No. 2
8	1	⅜ X 4½ X 13	Brace No. 3
9	2	⅜ X 14½ X 13	Top of bottom, front of back
10	1	⅜ X 14½ X 22	Bottom
11	1	⅜ X 14½ X 25⅞	Lower front
12	1	⅜ X 14½ X 3¼	Upper front
13	1	⅜ X 14½ X 18¼	Back No. 2
14	1	⅜ X 4½ X 14¼	High-freq.-spkr. base
15	2	½ X 6½ X 6⅞	High-freq.-spkr. mtg. left and right
16	1	½ X 6½ X 5⅞	High-freq.-spkr.-mtg. ctr.
17	1	⅜ X 15¼ X 22¾	Top
18	1		Low-freq. spkr. (woofer) Jensen P 12 P
19	3		High-freq. spkrs. (tweeters) Jensen P 5 TX

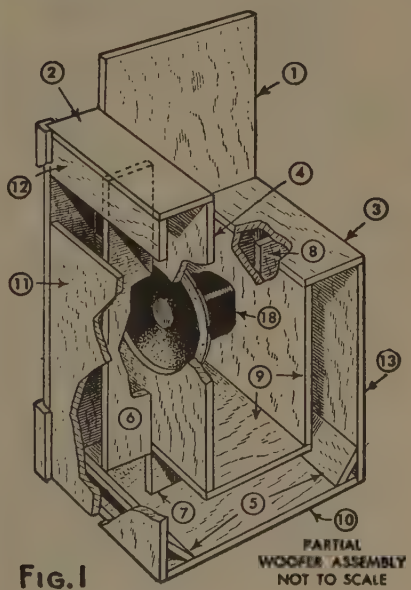


FIG. 1

with this system have a minimum of hum. Most table-type radios do not have sufficient filtering and many radio receivers have inadequate output transformers for both very high and very low tones. Several plans for suitable audio amplifiers can be had from the Radio and Electronics Department of *Popular Mechanics Magazine.*

The loudspeaker system, shown in photos A and C, takes less floor space than a radio console. The space required is only 15¼ in. wide and 22¾ in. deep. The height is 41 inches. The three tweeters are a special feature. Mounted as shown in photo D, and Figs. 3 and 4, they spread the high tones over a wide angle at ear level. This spread removes the annoyance of high-tone beams from a single source. For example, spread over a wide angle, the high tones of the applause and laughter of an audience are re-created realistically.

The tweeters are five-in. extended-range permanent-magnet (PM) speakers. Ordinary speakers do very well up to 10,000 cycles, but the extended range continues up to 15,000 cycles, so the added cost of the speakers specified is justified. The woofer is a single heavy-duty 12-in. PM speaker, front-loaded with a specially designed resonator and folded to conserve space. Most of the construction material is ⅜-in. plywood. Braces give the stiffness of much heavier material. Wire nails and glue are

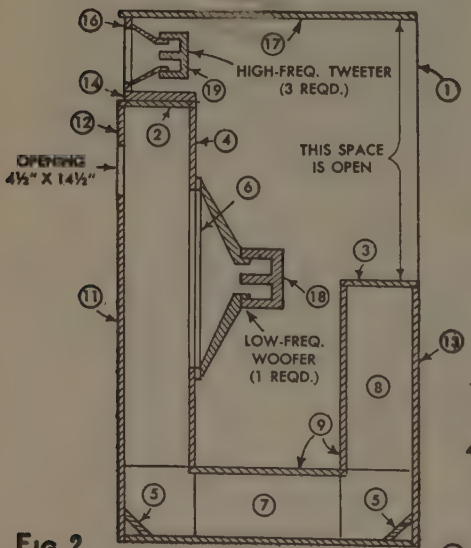
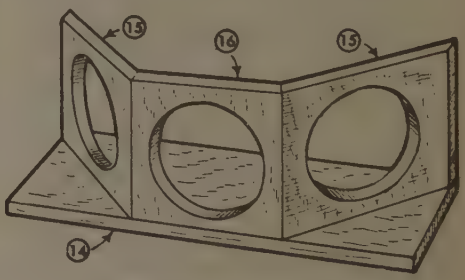
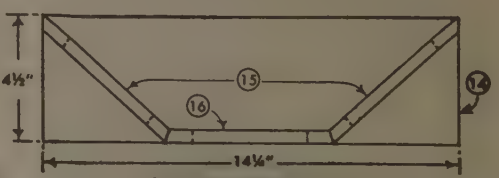


FIG. 2



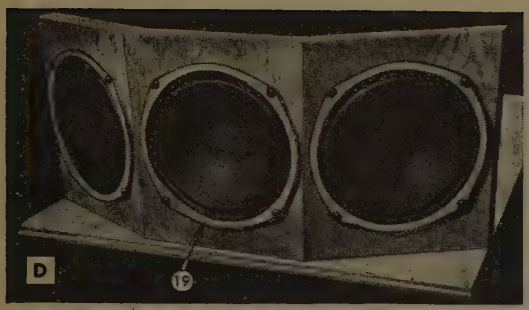
HIGH-FREQ.-SPEAKER MOUNTING

FIG. 3



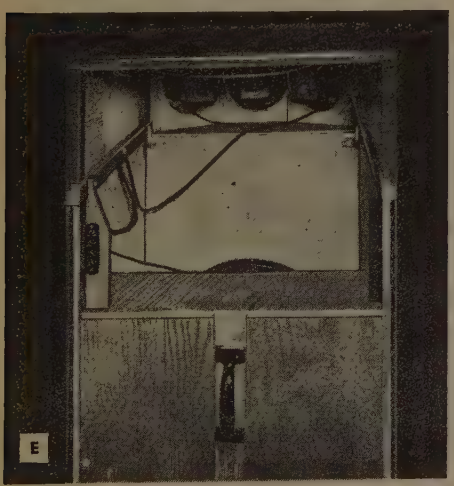
HIGH-FREQ.-SPEAKER MOUNTING
(TOP VIEW)

FIG. 4



used to make the joints airtight. Use water-resistant casein glue mixed with very little water. Incidentally, do not place this speaker system in operation until a day after assembly. Use large round-head wood screws to fasten the woofer securely. Lock washers are an added precaution against loosening caused by vibration of the heavy bass response. Note the vertical braces, items 6, 7 and 8, placed centrally between the sides, item 1 in Figs. 1 and 2. Also note the angles on items 15 and 16, the tweeter mounting boards. Some home-workshop saw tables show 0 deg. when the saw is set to cut 90 deg. You should cut a scrap piece and check the angles before making items 15 and 16. Fasten the tweeter assembly to item 2 (see Figs. 1 and 2) with wood screws, using a short-handled screwdriver.

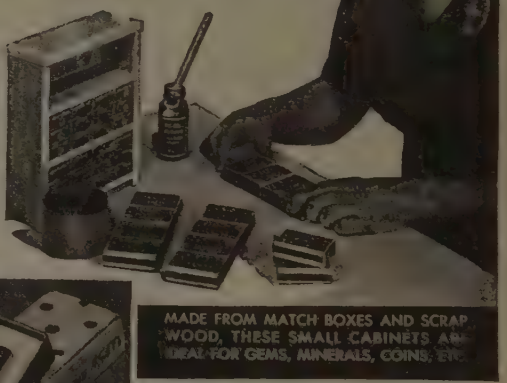
Detailed construction diagrams appear in Figs. 5, 6, 7, 8 and 9. The suggested trim, shown in Fig. 9, is black walnut, but any close-grained hardwood is acceptable. In applying trim, observe that the woofer "mouth" should be a full 4½ x 14½ in., as indicated in Fig. 2. Do not run the trim into this opening. A good place to install the grille cloth is under the trim. Do not use steel wool for finishing because particles of steel may get into the fields of the PM speakers.



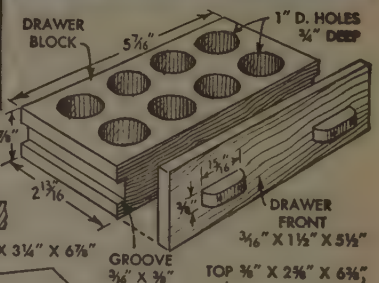
The main idea of the final network, photo B and Figs. 10, 11 and 12, is to get a maximum of low-frequency energy into the woofer. The parts specifications for schematic circuit diagram Fig. 10 are given above on Fig. 8. Enameled copper wire is preferred for the coil; single cotton-covered is next in preference. Make the coil sides of ⅜-in. plywood, 1 in. larger than the outside diameter of the coil. The center can be a cardboard tube. A few small brads will hold the tube to the coil sides. Use as little metal as possible near the coil. The coil can be held by two washers and a bolt for winding in either a lathe or hand drill. However, it also can be wound when held in the hand. Wind the wire in layers using tape between the layers, both to hold the turns and to make a neater following layer. The exact number of turns is not critical. The high-note control, Fig. 10, is necessary because of the high efficiency of the tweeters. As you play this assembly for the first time, you will be satisfied with a setting of half or less of the high-note control, R_2. Later, as you become used to high fidelity, you will probably want more of the clear high tones. The woofer can be switched in and out by means of the single-pole double-throw switch, S_1. Potentiometer control of the woofer is not recommended. This network unit is placed near the amplifier and is connected to the speaker system by means of cabled leads Q, QQ and X-ground indicated in Fig. 10. These cabled leads run to a terminal strip on the rear of the enclosure unit, photo E. When wiring circuit Fig. 10, note that only the positive (plus) connections of a dual electrolytic condenser (C_1) are used. Do not use the common negative. If separate electrolytic condensers are used, connect the negative leads together, but to nothing else. Paper condenser C_2 improves the high-frequency response. This network connects directly to the amplifier output; it will work satisfactorily with either the 8 or 16-ohm standard-impedance tap on the audio-amplifier output. The standard impedance of the five-in. tweeter speakers is four ohms. With the three connected in series, phasing is very important, see Fig. 11. Connect them in series for testing with a 1½-volt dry cell and note the motion of each speaker cone; they must all move the same way if they are phased properly.

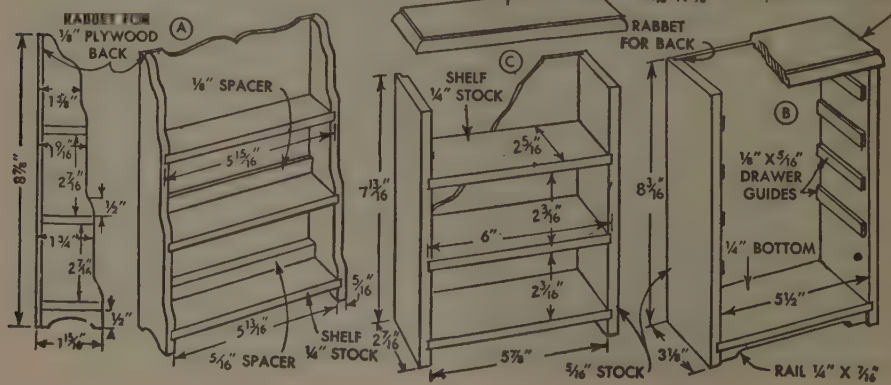
Miniature HOBBY CABINETS

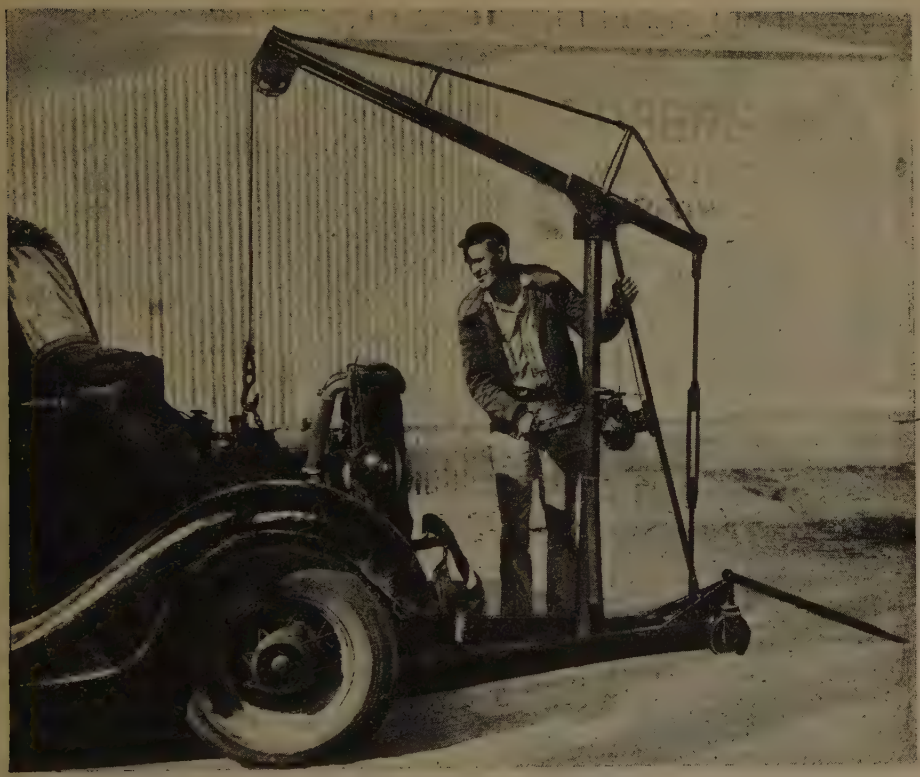
Small, neat and compact, these cabinets are ideally suited as display racks or containers for hobby collections of small specimens. The bookcase cabinet, A, holds 24 small matchboxes that may be removed individually like books. These may be covered with decorative paper as shown in the inset. Cabinet C has 36 matchboxes for drawers, the covers being glued together in three banks of 12. Pulls are pushpins which go through the box into ⅛-in. plywood inserts. Dimensions should be followed exactly so that the drawers can be opened without binding. Drawer blocks of cabinet B are of white pine, bored to take mineral specimens. The cabinets can be finished by staining and waxing, or they can be painted as desired.



MADE FROM MATCH BOXES AND SCRAP WOOD, THESE SMALL CABINETS ARE IDEAL FOR GEMS, MINERALS, COINS, ETC.





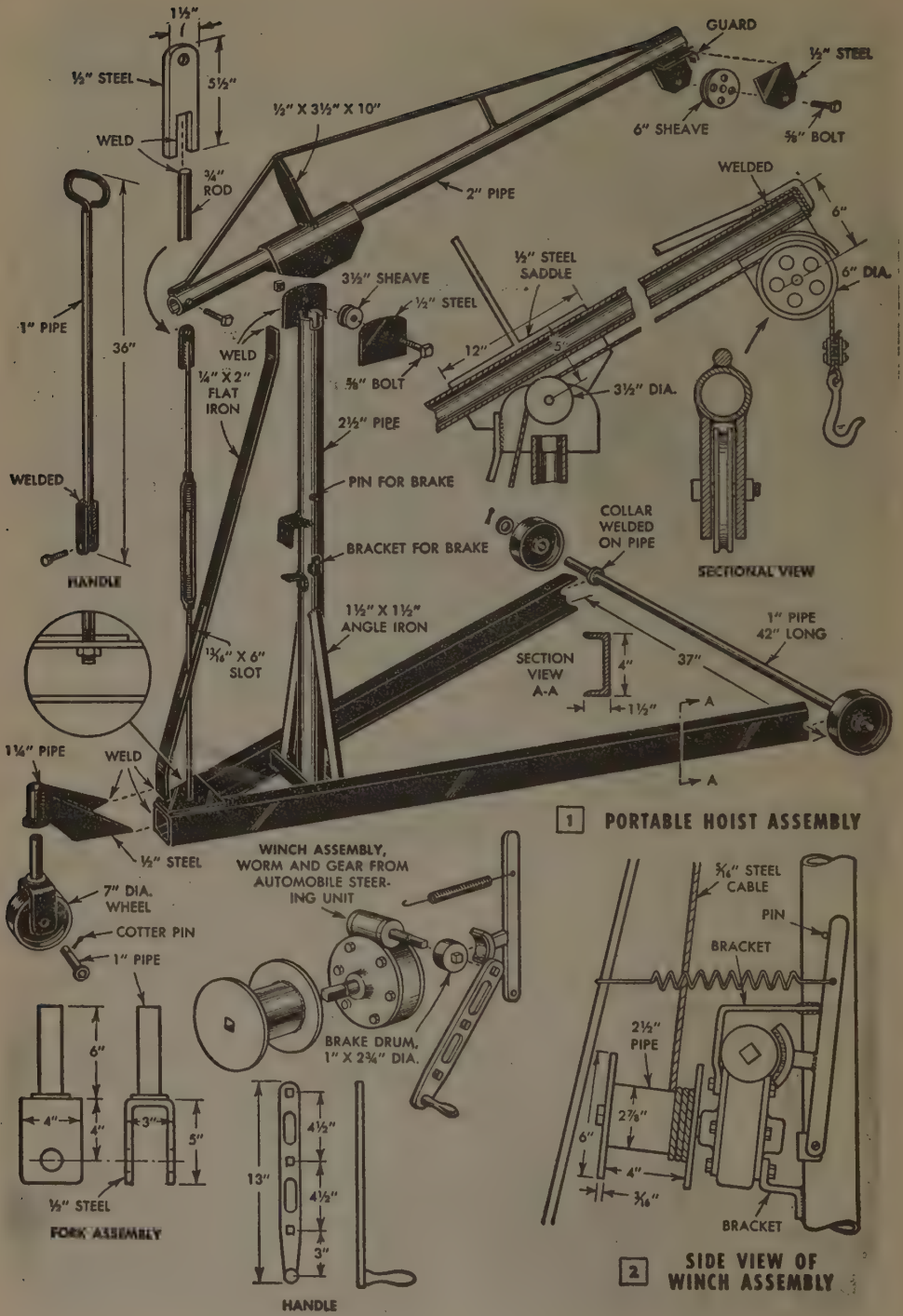


HOIST for JOB SHOPS

READILY adaptable for use in any job shop where heavy machine parts must be raised to exact height and rolled or swung into position, this portable hoist has several special features. The adjustable crane is mounted on a three-wheeled dolly having an A-shaped frame made from steel channels welded together as in Fig. 1 to form a rigid unit. The three-point support permits the unit to stand firmly on uneven floors while the hoist is being operated. The low dolly will roll under the front end of any car or truck so that an engine can be swung in or out of the frame by direct vertical lift of a worm-geared winch. The original portable hoist was constructed by a mechanic for use in his garage repair shop.

The crane pivots on a spindle mounted at the upper end of a supporting column which is braced and welded into the dolly frame, Fig. 1. A 3½-in. rope sheave is mounted on the pivot spindle as shown in the assembly and sectional views in Fig. 1. Dimensions of these parts are given in Fig. 3. The crane is adjusted for height by means of a large turnbuckle, one end of which is attached to the crane by means of a pivot bolt; the other end is threaded and passes through a hole drilled in a steel plate welded across the ends of the dolly side frames. Note that the column brace is slotted to permit the lower turnbuckle rod to pass through it and fasten to the frame.

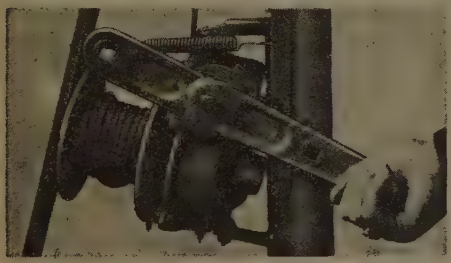
A caster-type front wheel fitted with a detachable handle makes it possible to maneuver the loaded crane into places where there are only inches to spare. The caster and its supporting arm are built up entirely by welding together members cut from flat steel, pipe and shafting. Note in the left-hand details in Figs. 1 and 2 that pipe is specified both for the caster-wheel spindle and the pivot shaft. If cold-rolled steel shafting is substituted, the assembly will operate more smoothly. The same is true of the rear dolly wheels and shaft. When steel shafting is used, the wheels should be bronze-bushed. If desired, the rope sheaves



1 PORTABLE HOIST ASSEMBLY

2 SIDE VIEW OF WINCH ASSEMBLY

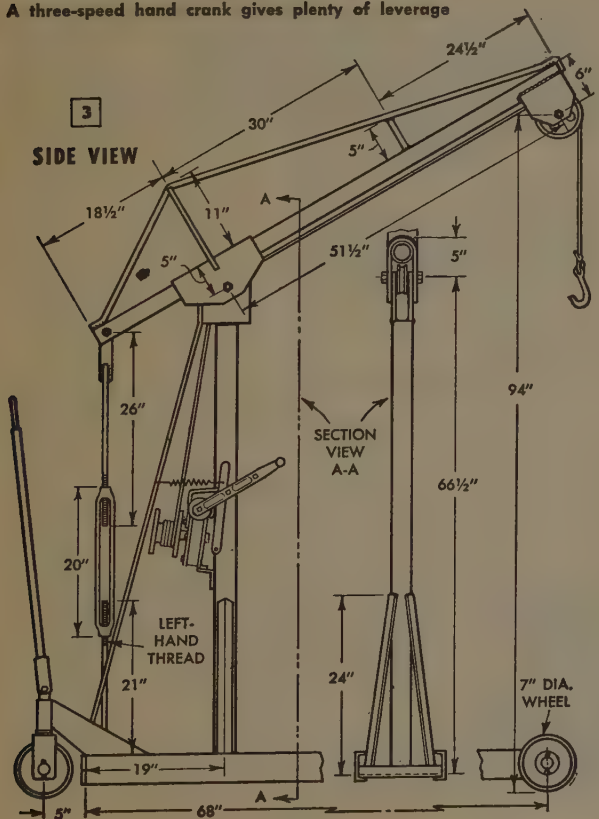
The winch is supported by heavy iron brackets welded to the round column. Note that the drum is tilted



A three-speed hand crank gives plenty of leverage

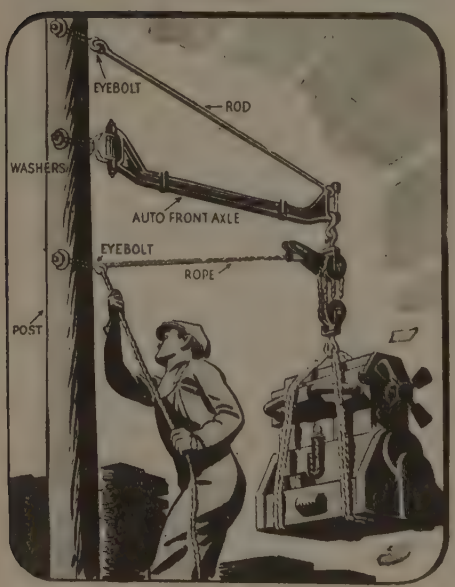
in the crane also can be fitted with bronze bushings for smoother operation. When assembling the spindle lugs for the 6-in. sheave, be sure that the parts are in line. If the sheave is not correctly aligned, the steel cable will tend to climb the flange causing undue wear on both the cable and sheave and possibly resulting in breakage. Note that a guard, or fender, is welded between the lugs carrying the upper sheave spindle and the free end is bent to conform to the curvature of the sheave. The guard prevents the cable from jumping out of the groove in the sheave when the hoist is being moved, or when the cable is being payed out or taken in without a load. Should the cable jump out of the groove, it may wedge between the sheave and the lug, making it difficult to free the parts without damage.

Assembly of the winch is detailed in Fig. 2. The necessary gear reduction to operate the winding drum is obtained by using an auto steering unit having a continuous worm gear. The worm-and-sector type of steering gear cannot be used satisfactorily. The winding drum is built up by welding steel disks to the ends of a short length of 2½-in. pipe. Holes are drilled in the disks and filed square to fit the squared shaft projecting from the worm-gear housing. Provide a cotter pin to hold the drum in place. The drum and gear housings are held in place on the crane column by two brackets shaped from flat iron and welded to the column as shown in Figs. 1 and 2. It's important that the assembly be placed at an angle so that it will align with the idler sheave. Weld another bracket to the column to carry the brake arm, Figs. 1 and 2. Fit a brake drum on the squared worm shaft. The lined brake shoe is supported by a lug welded to the brake lever as in Fig. 2. A torsion spring, attached to the brake lever and the column brace, applies sufficient pressure to prevent the drum from moving after it is stopped at any point. A stop pin welded to the column holds the brake shoe clear. Note that the handle, or crank, Fig. 2, is provided with three squared holes, equally spaced. The center hole and the one next to the handle give a short crank throw for raising or lowering the hoist quickly.



Hand-Operated Hoist Mounted on Trailer Bed Permits Controlled Dumping of Loads

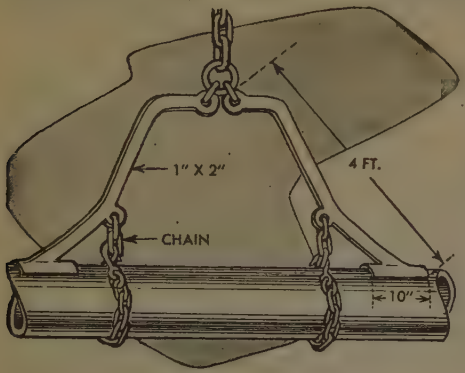
When unloading small grain into an elevator hopper or dumping sand for cement work from a trailer bed, a hand-operated hoist has several distinct advantages. When unloading grain, the rate of flow from the endgate port can be controlled closely. When unloading other materials the entire load or only a small part of it can be dumped. The hoist frame is made from steel angles and is mounted on the forward end of the stationary bedframe. Steel cable from the winch drum passes through a single sheave mounted at the top of the hoist frame, while the free end is attached to the pivoted bedframe. The winch, which is equipped with a ratchet, is mounted on a flat-steel bracket and is fitted with a crank having a 12-in. throw.



Hoist for Heavy Loads Improvised From Front Axle of Car

Pivoted to a tall post, tree or side of a building, the front axle of an old car provides a strong, swinging arm for a block and tackle used in lifting heavy loads. This hoist is especially useful on farms for lifting out tractor and truck motors, for suspending heavy animals at butchering time, and other such tasks.

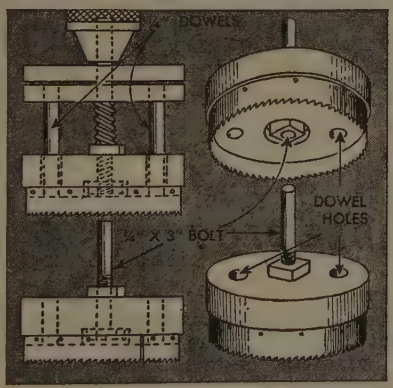
Hoisting Tongs Provide Safe Hitch for Lifting Heavy Pipe or Poles



Designed and used by a western contractor engaged in loading power poles, these safe hoisting tongs work similar to a pair of ice tongs—the weight of the object tends to increase the grip. Chained to the load near the point of balance, the tongs keep the load in a horizontal position when lifted. The tongs are made from 1 by 2-in. flat iron, heated and bent to the shape shown. Eyes are welded to take a hoisting ring at the top and two grab chains which wrap around the load. Cupped saddle plates are welded to the ends of the tongs to ride the curvature of the particular pipe or pole being lifted.

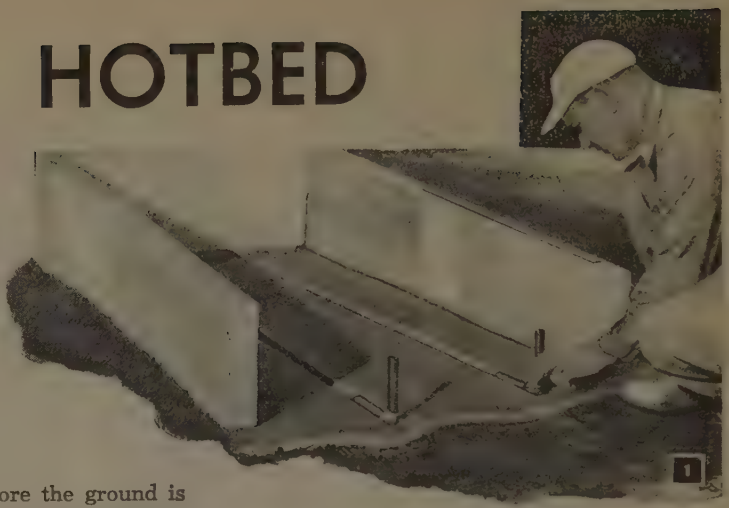
HOLE SAW

Homemade Hole Saw With Removal Disk Increases Production



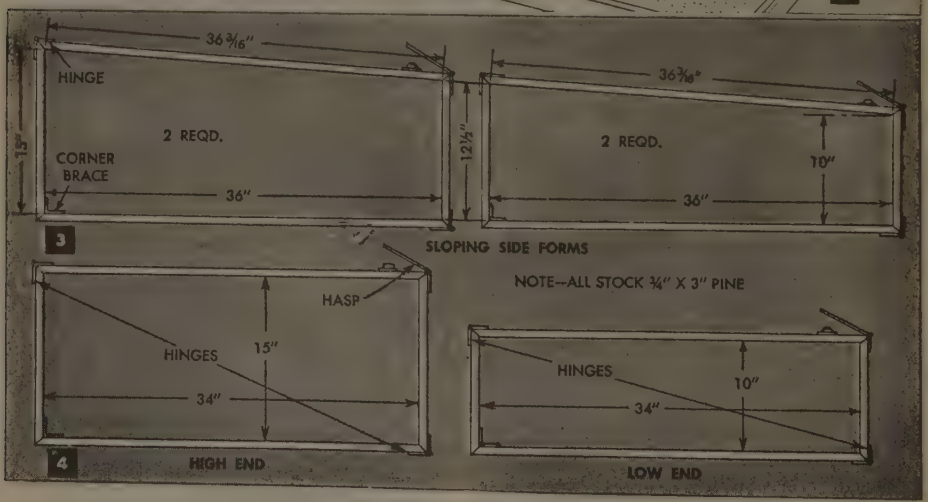
Here is a hole-saw attachment for a drill press that speeds up the cutting operation by permitting the stock removed to be ejected from the tool while the drill press is running. Using an ordinary hacksaw blade, wood up to ¼ in. thick can be cut. A wider blade, of course, allows working with heavier stock. A 12-in. hacksaw blade will provide a saw with a maximum diameter of about 3½ in. The tool is made by cutting a disk from ¾-in. wood about ¼ in. larger in diameter than the desired size of the saw. Then, the disk is drilled to take a ¼ x 3-in. bolt, countersinking the bottom of the disk for the nut. It also is drilled for two ¼-in. dowels. The head of the bolt is cut off so it can be chucked in the drill press and it is fastened to the cutter as shown. A shoulder 3/16 in. wide is turned on the underside of the disk to the exact diameter of the finished tool. This may be done by chucking the unit in the drill press and improvising a tool rest. To mount the hacksaw blade, heat it to a dull red and cut off one end square. Next, drill small holes near the top edge of the blade at intervals of about 1 in. Heat the blade again, if necessary, and bend it to the desired radius. However, be sure to bend the blade so that the teeth will be in proper cutting position after it is mounted. Finally, nail the blade to the cutter disk, starting with the squared end, and trim the other end to fit snugly against it. The ejecting mechanism consists of two disks of ¼-in. plywood drilled to slide over the bolt. The lower disk is fitted with ¼-in. dowels aligned with the holes in the cutter disk. A spring and then the lower disk are placed over the bolt, and dowels are inserted in the holes. The upper surface of this disk is waxed to permit the top disk to be grasped during operation without interfering with the rotation of the cutter. The drill-press chuck serves as a stop for the spring.

HOTBED



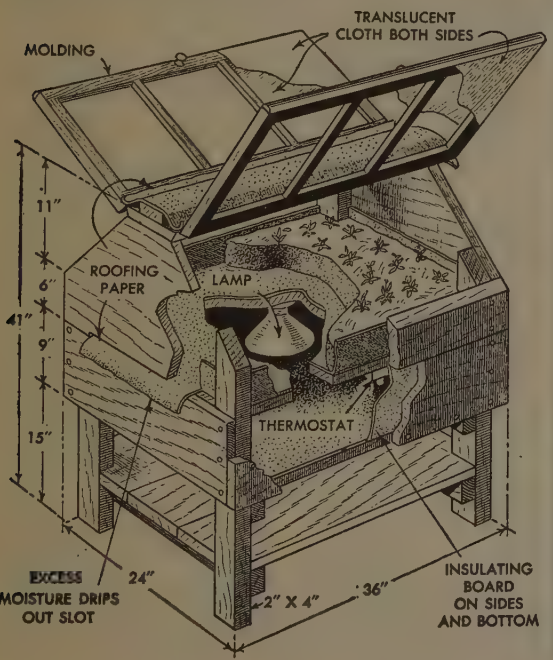
At right is the installation for the subsurface watering of concrete hotbeds. Watering channels are formed by pressing a length of 2-in. pipe into the concrete

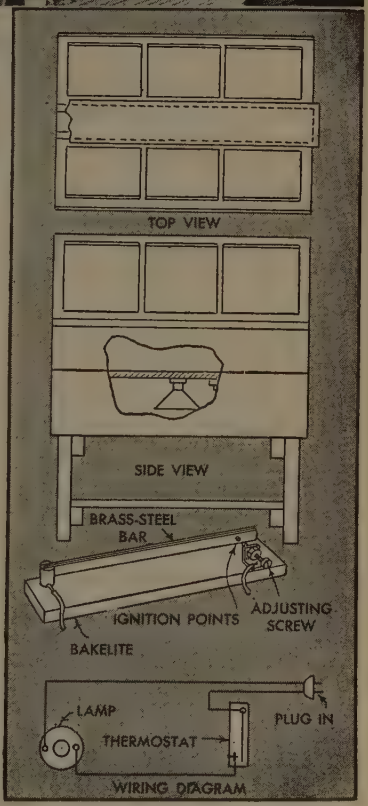
ANY TIME before the ground is frozen is the time to build concrete hotbeds. First make hinged forms as in Figs. 3 and 4. Diagonal corners on each form are hinged so that a side and one end open outward. On the upper left-hand corners of both side forms, Fig. 3, the mitered ends are cut at a greater degree so that the hinged side will close. To cast the parts, place the frames on a level surface, Fig. 2, then fill with cement and strike off level. Set the precast sides and ends on a freshly poured concrete bottom, Fig. 1, and form water channels in the bottom with a length of pipe. Screw two ½-in. pipe nipples into an elbow and place one of these units in each channel. Water is poured into these through a funnel.



Electrically-heated CABINET HOTHOUSE *has uniform temperature*

JUST the thing for growing tender plants or for starting garden seedlings early, this compact little hothouse can be moved about at will, and maintains a uniform temperature for the plants by means of a 100-watt lamp that is controlled by a homemade thermostat. This consists of a strip of brass and a strip of steel sweat-soldered together, fitted with suitable points, and mounted as shown in the lower right-hand detail. The house is divided into two compartments, one for the heating unit and one for the soil. The heating compartment is insulated on the sides and bottom and the soil compartment is lined with asphalt roofing paper, which extends out through a slot at one end for escape of excess moisture. Two hinged frames serve as a roof for the house, and are covered on both sides with translucent cloth, which admits both light and the ultra-violet rays from the sun.





HOT-WATER HEATER INSTALLATION

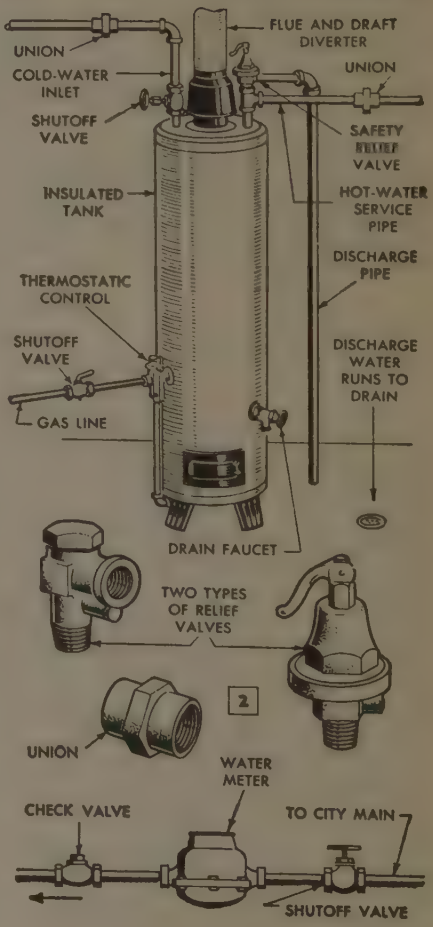
Hot-water heaters of the automatic types designed to use electricity, gas or oil are available in a wide range of sizes for new installations. There also are special conversion units which can be installed in tanks connected to older-type furnace coils or other sources of heat. One of these is a simple electrically operated immersion unit which can be installed in any existing tank to convert it to full automatic operation at very litle cost. Another inexpensive unit is a thermostatically controlled gas valve especially designed for converting a hand-controlled gas heater of the older type. Although these newer units are fully automatic in operation, they require periodic checks to keep them operating at peak efficiency. Before installing a new heater, it's a good idea to check costs of electricity, gas and oil in your locality so that you can install the heater utilizing the most economical fuel.

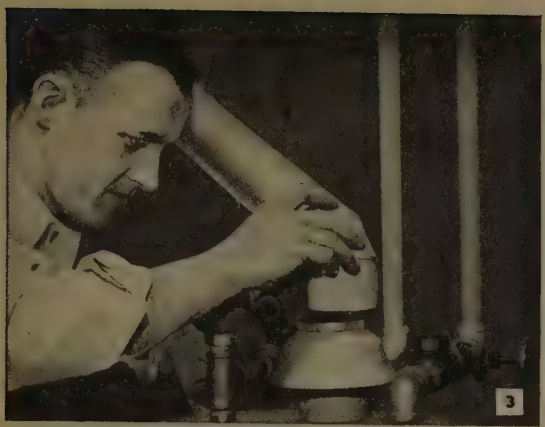
1

Safety controls: The safety valve is an automatic outlet relieving pressure in a boiler or hot-water system. Two types are the spring valve and the dead-weight valve. Each works on the same principle, that of a loaded plug or flap closing an opening until the pressure within rises sufficiently to lift the plug. In the spring-loaded type, the spring forces the plug, or valve disk, into the steam outlet, so that the disk closes the opening, while the ball-shaped plug is retained in position by means of the weights, the setscrews preventing the valve top being blown off.

Safety valves are adjustable, so that they can be set to blow off at different pressures as the occasion arises, or they can be built to work at one pressure only, to suit the pressure of the particular system on which they are to be used.

As heated water expands and tends to build up excessive pressure in the boiler, every automatic water heater must be provided with safety controls on the burner unit and also should be fitted with a pressure-relief valve, Figs. 1, 2 and 4. One type of relief valve opens when excessive pressure develops and also is fitted with a fusible plug that melts at about 210 deg. F. The pressure element usually is adjustable to open under pressures ranging from 50 to 125 lbs. per sq. in. Of course, the fusible plugs are replaceable, several being supplied with each new unit. Two types of these valves are shown in Fig. 2. Some other types of relief valves have a manual tripping mechanism that should be test-operated once or twice a year to see that the valve is in reliable working condition. In some installations it also is necessary to install a check valve in the cold-water line





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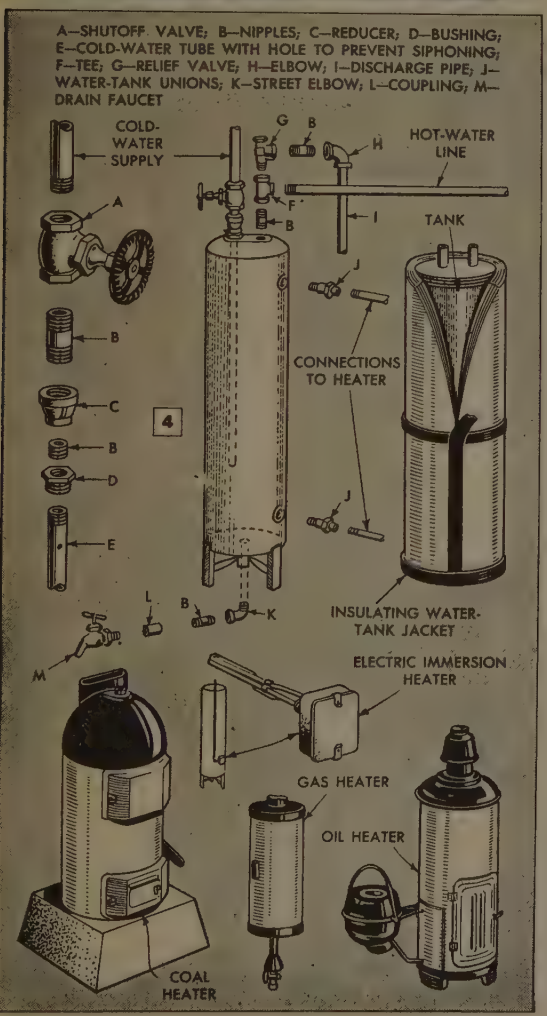
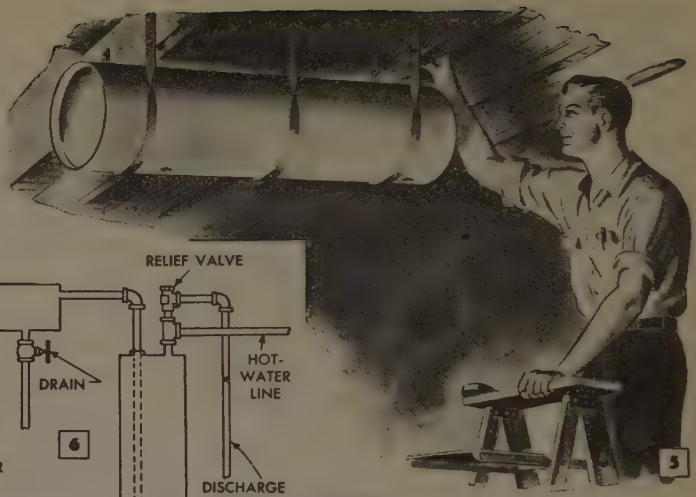

A—SHUTOFF VALVE; B—NIPPLES; C—REDUCER; D—BUSHING; E—COLD-WATER TUBE WITH HOLE TO PREVENT SIPHONING; F—TEE; G—RELIEF VALVE; H—ELBOW; I—DISCHARGE PIPE; J—WATER-TANK UNIONS; K—STREET ELBOW; L—COUPLING; M—DRAIN FAUCET
COLD-WATER SUPPLY
HOT-WATER LINE
TANK
CONNECTIONS TO HEATER
INSULATING WATER-TANK JACKET
ELECTRIC IMMERSION HEATER
GAS HEATER
OIL HEATER
COAL HEATER
4

as shown in Fig. 2. This valve protects the water meter from being damaged should hot water back up against the normal pressure in the water line. Electric heaters are controlled by thermostatic switches which ordinarily do not require attention. The heating unit is turned on and off automatically between the heat ranges for which the thermostat is set. Automatic gas-fired water heaters have thermostatically controlled burners which maintain uniform water temperatures and will shut off the gas supply completely in case the pilot light goes out.

Pipe and flue sizes: Pipe connections on the heater tank determine the size of pipe to use in connecting the unit to the water supply lines. The main hot-water lines usually are of ¾-in. pipe while ½-in. pipe is used for branch lines. Pipe smaller than ½ in. should not be used. Pipe runs from the heater to existing lines are connected by means of unions as in Fig. 4. Of course, electric heaters do not require flues, or vents, but all gas, oil and coal-fired water heaters require flues either to an existing chimney, or direct to the outside. Many homeowners install vent pipes, or flues, of stainless steel as this material does not corrode. Gas and oil-burning water heaters should always be fitted with a draft diverter of the type in Figs. 2 and 3.

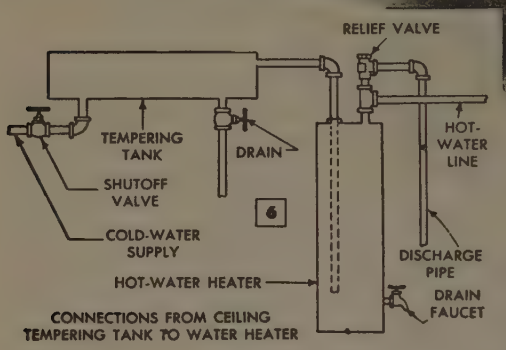
Water-heater installation: Gas and oil-burning water heaters are comparatively easy to install. Just place the unit on a level floor, or a concrete base 2 to 3 in. thick, and as close as possible to a flue opening in the chimney. Flue or vent-pipe sizes generally are 3 to 4 in. in diameter for gas, 4 to 5 in. for oil and 4 to 6 in. for the coal-burning heater. In connecting the gas and oil supply lines, follow the directions of the heater manufacturer in all details. A shutoff valve should be installed in the cold-water line near the tank and, in oil-burning heaters, it is customary to install a valve in the fuel line near the burner, as in Fig. 2. A shutoff valve is not required in the hot-water line. Never locate a shutoff valve between the relief valve and the tank.

Hot-water-storage tanks having



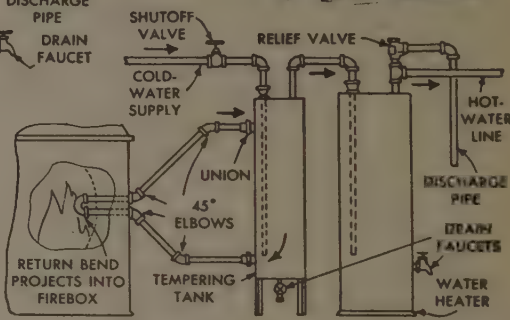
A tempering tank saves on water-heating costs. Such tanks are generally installed overhead, being hung from joists with flat-iron bands

5



6

CONNECTIONS FROM CEILING TEMPERING TANK TO WATER HEATER



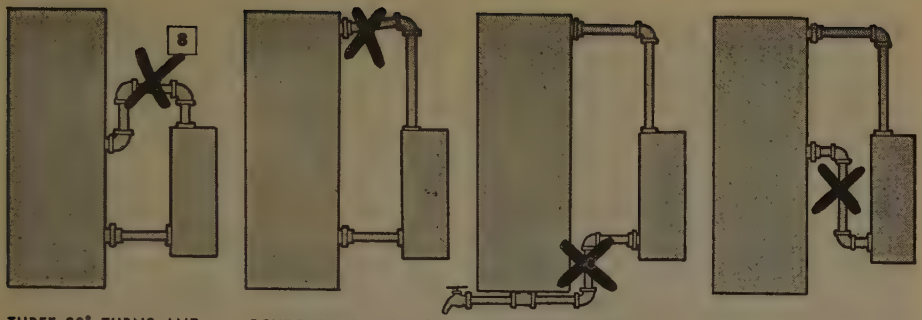
ARRANGEMENT TO HEAT WATER IN TEMPERING TANK ABOVE ROOM TEMPERATURE

7

no built-in heater units have six standard tappings and come uninsulated. The tank stand, pipe fittings, relief and drain valves and the cold-water tube are installed as in Fig. 4. The cold-water tube, preferably of brass, usually is about 4 ft. long for a 5-ft. tank. It extends inside the tank so that cold water is discharged near the bottom to prevent cooling the hot water above. A small hole is drilled near the top end of the pipe, its purpose being to prevent hot water from being siphoned out of the tank when cold water is drawn from the system at a level lower than the top of the tank. After installing the storage tank it will pay to insulate it as in Fig. 4. This will prevent a 15 to 30-percent heat loss by radiation. It also is advisable to insulate long runs of hot-water pipe for the same reason.

Connecting separate heater: When separate heating units of the gas, coal or oil-fired types are hooked up to hot-water storage tanks, inefficiencies in heating are caused by faulty installations such as those detailed in Fig. 8. Gas-fired side-arm heaters should be connected as in Fig. 9, and as in Fig. 12 when a water back is used in the furnace or boiler. The hot-water pipe from the heater to the tank should rise vertically from the heater and then run horizontally to the tank connection. When making the right-angle bend, use two 45-deg. elbows and a short nipple rather than a single 90-deg. elbow. Fig. 9 also shows the installation of a thermostatic gas-control unit for full automatic operation of the heater. If desired, an electrically operated immersion unit, Fig. 4, can be installed in place of the side-arm gas heater. This unit also is controlled automatically.

Tempering tanks: Worth-while savings can be made in water-heating costs by the installation of tempering tanks in which cold water is preheated to room temperature before entering the heater tank. Figs. 5, 6 and 7 detail common methods of installing tempering tanks. In ordinary installations, it is regular practice to hang the tank from the floor joists as in Figs. 5 and 6, but it also can be arranged as in Fig. 7 and connected to a heating coil in the boiler or furnace. A 20 or 30-gal. tank usually is sufficient for either type of installation. The ordinary pipe connections are shown in Figs. 6 and 7. Note that in both types of installations drain valves are provided. In a coal-fired furnace or boiler the water coil projects only a short distance into the firebox. On furnaces or boilers in which intermittent flash heating with gas or oil is used,



THREE 90° TURNS AND DOWNWARD FLOW OF HEATED WATER RETARDS CIRCULATION; CENTER CONNECTION TO TANK NOT ADVISABLE

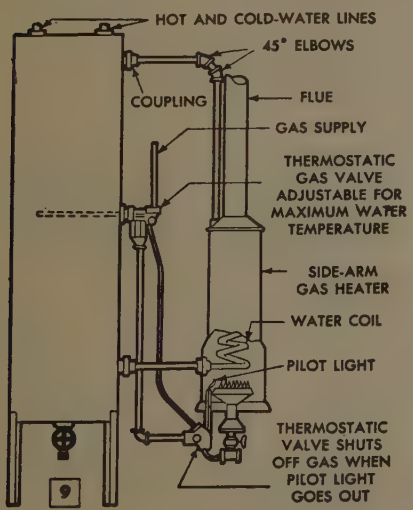
DOWNWARD TRAVEL OF HEATED WATER TO TANK RETARDS FLOW. USE SHORTER VERTICAL PIPE TO GET UPPER ONE HORIZONTAL

COLD-WATER RETURN AT TANK BOTTOM PERMITS SEDIMENT AND RUST TO CIRCULATE WITH WATER; SEDIMENT WILL CLOG LOWER PIPE

COLD-WATER RETURN FROM CENTER OF TANK KEEPS LOWER PORTION TOO COLD AND UPPER PORTION TOO HOT

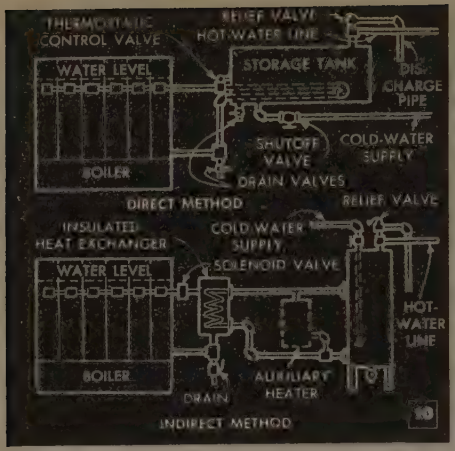
the return bend of the coil must be inserted farther into the firebox in order to obtain satisfactory results from the installation.

Heat exchangers: In many homes, various installations are used to warm the water in a storage tank by piping in steam or hot water from the boiler. In some cases a steam or hot-water coil is submerged directly in the storage tank. The details in Fig. 10 show both the direct and indirect types of hookups for this purpose. With the indirect method, water from the storage tank flows through a coil submerged in a smaller tank in which hot water from the boiler is circulated. A coil connected to a storage tank may be placed inside a steam or hot-water boiler below the water line. In these systems steam or hot-water lines from the heating plant are automatically opened and closed by thermostatic valves or by aquastats on the storage tank, which prevents overheating of the water. Very often heating plants equipped in this way are used throughout the summer season for heating water. In these installations special controls are installed to prevent circulation of heated water or steam throughout the heating system. As a rule, however, an auxiliary water heater, shown by the dotted lines in the lower detail in Fig. 10, is used during the summer months.



Water backs: A water back, Fig. 12, should always be installed in the furnace or boiler in a level position, as otherwise a pocket of live steam may form at A, and blow back periodically through the line into the storage tank, causing a sharp, metallic hammering which in time will damage the installation. Water backs generally overheat during the coldest weather when the heating plant is operating over long periods at full capacity. The lower detail in Fig. 12 shows one practical way to utilize excess heat from the installation by circulating the water through a radiator installed in a room directly above the storage tank. This type of installation is frequently used when hot water is drawn from the storage tank only at comparatively long intervals.

Liming of heating coils: In localities where only hard water is available, heating coils in side-arm heaters, water backs and furnaces gradually become coated inside with deposits of lime. This hard coating not only acts as insulation, requiring more and more heat to keep up the water temperature as the coating thickens, but it also restricts the water passage and eventually clogs the coil. Hot water circulating through a restricted passage may cause such severe hammering that it will loosen the pipe joints and cause leakage. The remedy, of course, is then to install a

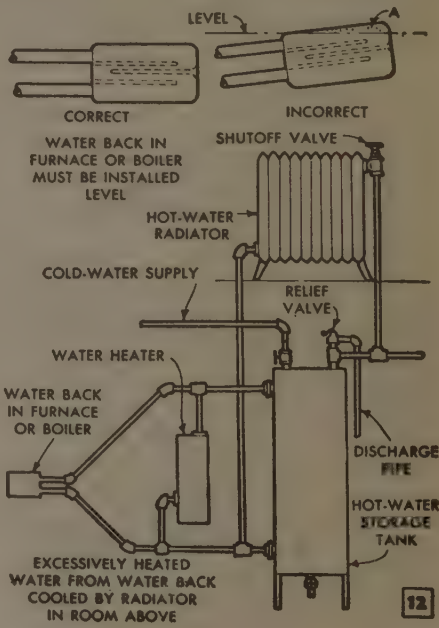


water softener and replace the faulty coil.

Flushing and refilling storage tank: Impurities contained in water settle to the bottom of hot-water storage tanks and form a film of sediment across the bottom of the tank. It's a good idea to open the drain faucet at the lower end of the tank once a month and drain off 2 to 4 gal. of water. This precaution will remove most of the accumulated sediment and keep the tank comparatively clean. However, a thorough flushing of the tank at least once a year is advisable. To do this, shut off the heating unit and close the valve in the cold-water supply line. Open a hot-water faucet at a level above the tank. Then drain the tank completely. Leave the drain faucet open and turn the valve in the cold-water line full on so that the full force of the water strikes the tank bottom. This will dislodge sediment and wash it out through the open drain faucet. In some cases it will help when cleaning and flushing an older tank to remove the cold-water tube and insert a hose so that a forceful stream of water can be directed around the sides and across the bottom of the tank. After a thorough flushing, close the drain faucet, open the cold-water valve and refill the tank and the line until water runs from the hot-water faucet. Then start the heating unit. When flushing tanks connected to a cast water back, do not fill the tank with cold water until the water back has cooled sufficiently to prevent breakage. On automatic gas heaters the baffle tube in the vent should be removed at intervals and cleaned as in Fig. 11. Wipe off all the dirt and rust which have collected and then swab the vent tube, or flue, with a stiff-bristle flue brush. Be sure to replace the baffle in the same position as it was originally. Periodic cleaning of the flue and baffle gives faster heat transfer and there will also be greater economy in water-heating costs.

Leaky drain faucet: Sometimes a persistent leak will develop in the drain faucet at the bottom of the tank. Usually it will be necessary to drain the tank in order to make a reliable repair. As a rule, a thorough cleaning of the parts and the installation of a new washer will stop the leak unless, of course, the seat is badly corroded.

In gas installations it is likely that the work will have to be approved by your local utility company before the gas is turned on.

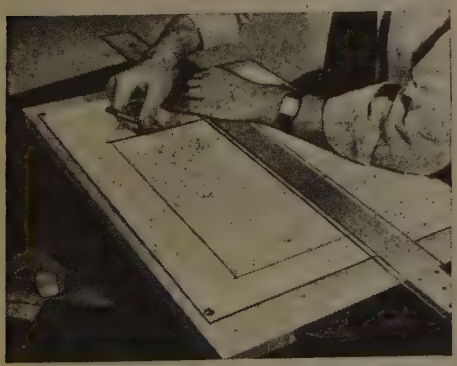


HOUSE MODEL-MAKING

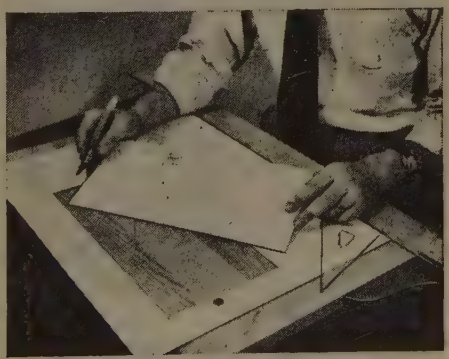
USING inexpensive materials and the simplest of tools, you can build, in a few hours, a true scale model of that home you have planned. A model of cardboard, even a simple one, not only gives a realistic, three-dimensional view of the home before it is built, but a careful study of the model may save you a lot of money by showing up impractical or costly features before actual construction of the house begins. In a simple floor-plan sketch it may appear that you have all that you desire in convenience and comfort, but a scale model likely will show minor changes, which will make the arrangement even better. On the other hand, it may reveal beforehand structural defects or a faulty room or interior arrangement. With the four walls of a model in place in a scale reduction of a plan, you can determine size, location and number of windows and doors, locate partitions and decide on room sizes and arrangement easily, because you can see how these details will appear in the full-size structure. It's quite as easy to pick the type of roof, the most advantageous location of the house on the lot and the height of the chimney in relation to the ridge. It's also possible to decide on the smaller exterior details and the color of the paint job as well. All these points should be decided definitely before you build.

To lay out a plan accurately to scale you will need a draftsman's T-square, a 45-deg. triangle, a pair of dividers, a small drawing board, thumbtacks and a triangular scale showing common scale reductions.

Begin by thumbtacking a piece of illustration board to the drawing board. Then, with the scale, lay out the size of the lot, using a scale of ¼ in. equals 1 ft. For some types of construction a scale reduction of ⅛ in. equals 1 ft. is practical. Mark the property boundaries on the board. Then, using the same scale reduction, lay out the floor plan of the house on another sheet of

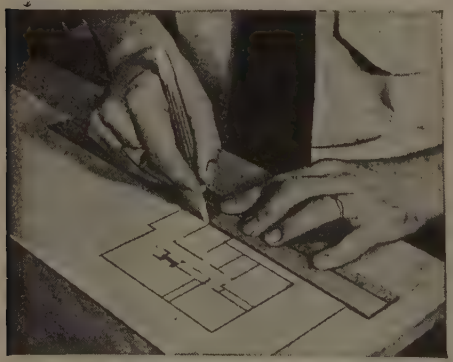


Lay out the exact scale size of your lot on heavy illustration board and mark boundary lines in pencil. Use the common reduction of ⅛ or ¼ in. to 1 ft.

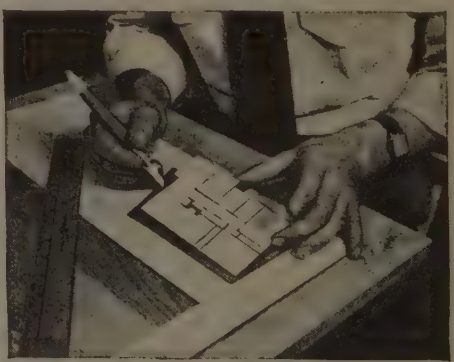


Cut out the lot, using a metal-edged ruler and a sharp, thin-bladed knife. Hold the blade in a vertical plane so the edges of the board will be square on all sides

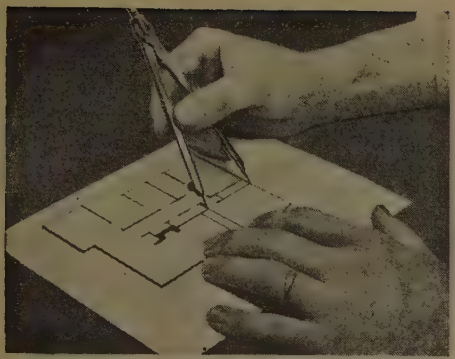
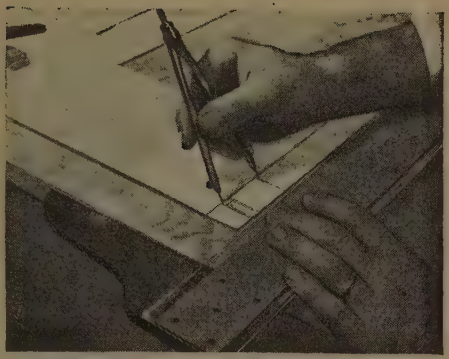
illustration board. Scale the thickness of the walls and mark the inside over-all dimensions of the floor plan. Then cut on the inside lines. Cement this cutout in place on the plan of the lot in exactly the same location as the full-size house is to be. This method of cementing the floor-plan piece to the board on which the lot plan is laid out makes it easier to position the walls. Use your T-square and triangle to get parts laid out exactly at right angles and be careful about the measurements. Lay out the location of the partitions next. Photos on page 186, beginning at the top and reading left to right, show the use of draftsman's dividers in laying off measurements accurately when locating partitions and other plan details. The next two photos left to right, show the house plan being cemented in place on the lot. Use airplane cement for this purpose as it sets quickly and does not discolor. Next, determine the scale height of the outside walls and partitions. Mark off and cut strips of the illustration board

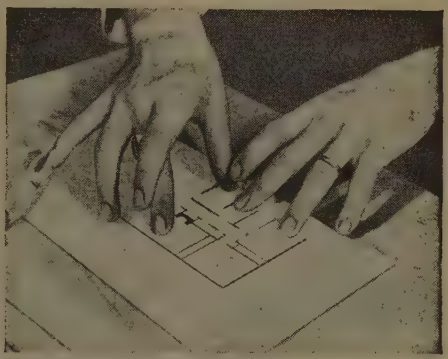
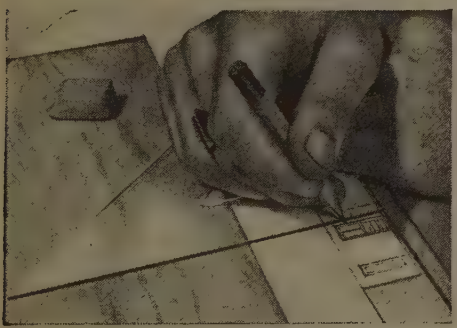


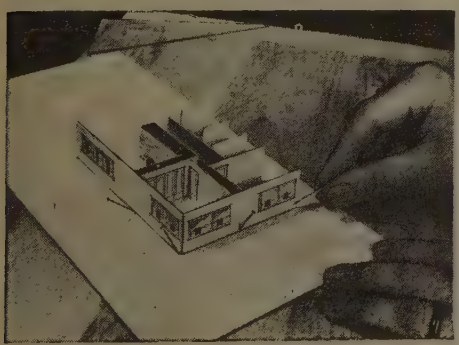
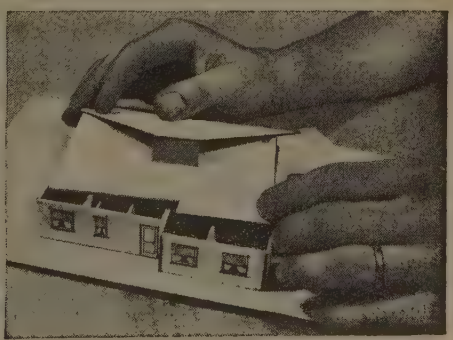
On another board lay out the house plan. Mark the partitions. Plan should be an exact scale reduction of the inside dimensions measured from wall to wall

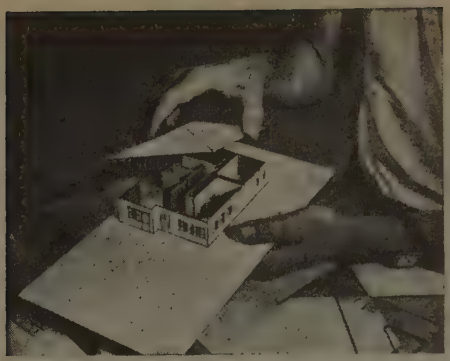


Then cut out the floor plan on the lines, being very careful to hold the knife perpendicular to the board so the edges of the cutout will be square and smooth

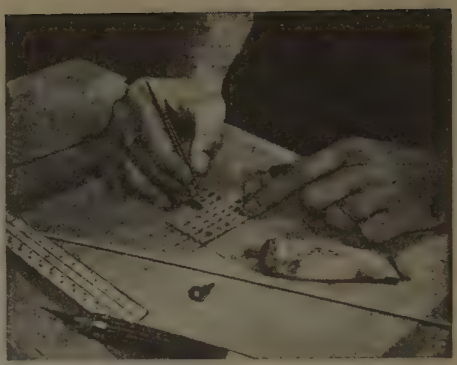



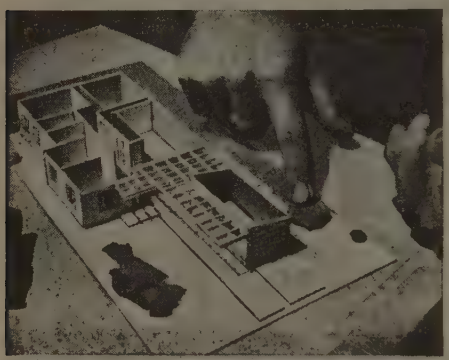





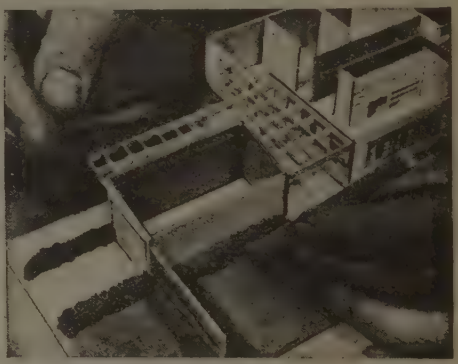
The ceiling and roof are made as a separate unit to lift off, exposing the arrangement of the rooms



A trellis, arbor or fence can be built from strips of pine or balsa wood, cemented together in sections



Colored modeling clay is used to form shrubbery and hedges. Strips cut from a sponge also can be used

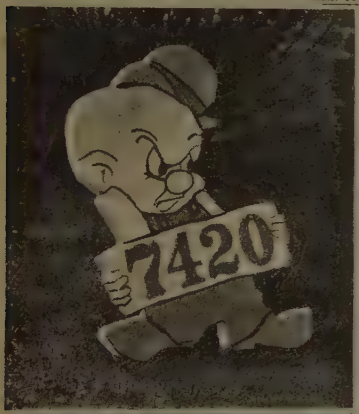


Finishing the modeling-clay shrubbery with the splintered end of a stick gives a realistic effect of foliage

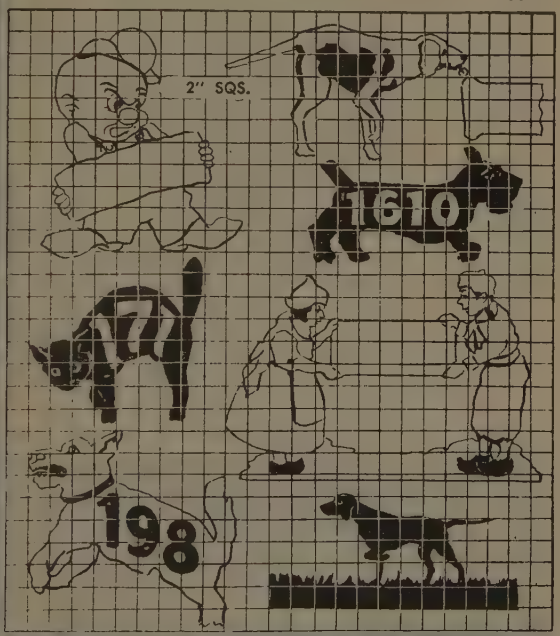
so that you can cut pieces of partition and wall stock as required. Remember that the height of the partition strips must allow for the thickness of the cemented floor plan so that outside walls and partitions will be the same height when assembled. Scale-sized windows and doors are represented by drawing the outlines directly on the walls with black ink, or with pencil, as in the left-hand photo, third row, page 186. When setting up partitions and walls, use the triangle as in the right-hand photo, third row, so that when the cement dries the parts will stand true vertically. Hold the outer walls with pins as in the lower left-hand photo. On most plans you can cement all the partitions in place before setting the outside walls. At this stage, with the exterior walls in place, cut a ceiling piece of the exact outside dimensions of the floor plan so that it overlaps the thickness of the walls on all sides. This gives you a foundation on which to build the roof. If the house has a boxed cornice, then the ceiling piece should extend beyond the outer walls a scale distance equal to the overhang of the cornice. Build the roof in sections as in the lower right-hand photo, page 186, using small blocks of wood to elevate the sections to the correct pitch. Carve the chimney top from a small block of wood to scale size, score it, or line with ink to represent bricks, and cement it to the roof. By this method of construction the roof and ceiling can be lifted off as a unit to show the room interiors.

The garage, sidewalks, service court, yard fences, trellis or pergola, trees, shrubs and the garden are exterior details on which you will have to use your own ingenuity, as the details and plantings will vary with the lot and locality. Hedges and shrubs can be worked out with modeling clay. Artificial trees are available, trellises and fences are easily carved from pine or balsa wood. Build the garage from the house materials and lay out and assemble it in the same way. Paint the model with painter's oil colors thinned with turpentine to an easy brushing consistency. Use soft-bristle brushes to spread the paint in a uniform coating on the small surfaces.

HOUSE NUMBERS



Nothing is more appreciated by your callers than a well-designed house number located where it is easy to see. The lawn is the ideal place, so try your hand at some of these. A jig-saw or coping saw and some ½ or ¾-in. outdoor plywood are all you need. Stakes of ½-in. pipe will make ideal supports



HOUSE TRAILER

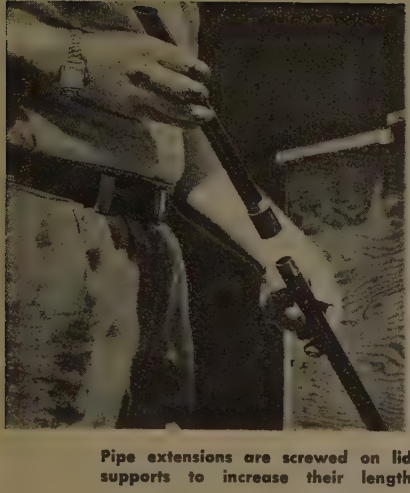
LIKE SO MANY outdoor-loving Americans, my family thoroughly enjoys spending its vacations and long week ends camping out—roughing it, so to speak — while exploring the many lakes and back trails of this great U.S.A. After having roughed it several summers in true Boy Scout style, we decided to design and build a camping trailer that would incorporate "all the comforts of home" in a compact, two-wheel job capable of being trailed safely at highway speeds.

Having two boys, Bruce and Craig, I knew that the trailer would have to sleep at least four. It would have to be small enough to park in my two-car garage, and it would need a roomy ice chest to handle an ample food supply. It also would have to afford adequate protection in bad weather and, preferably, be collapsible, which meant finding a way of erecting and dismantling it without a lot of work.

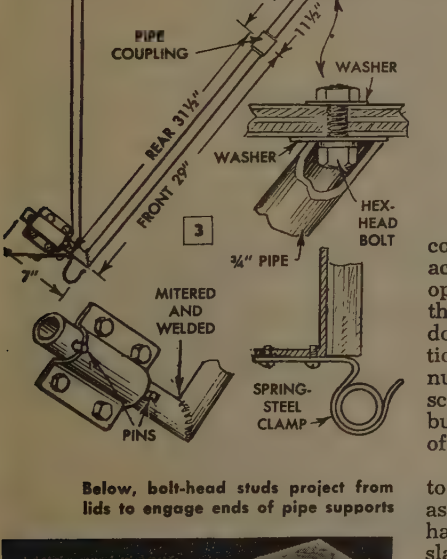
In short, a fold-away "tent" on wheels was what we needed.

The trailer you see pictured below fulfills all these requirements. And, after having put it through a tour of the West last summer (a grueling test of some 5000 miles), we found the trailer towed beautifully, provided all the comforts we had hoped for and caused a mild sensation wherever we set up camp or pulled stakes. When open, each overhanging wing of the trailer to which the tent is permanently attached, accommodates a full-size air mattress to provide comfortable sleeping for four. The deep insulated ice chest at the front of the trailer is easy to reach both when the trailer is open or closed. The boys found this feature especially convenient for getting Cokes and other treats while on the road. Likewise, two lock-fitted

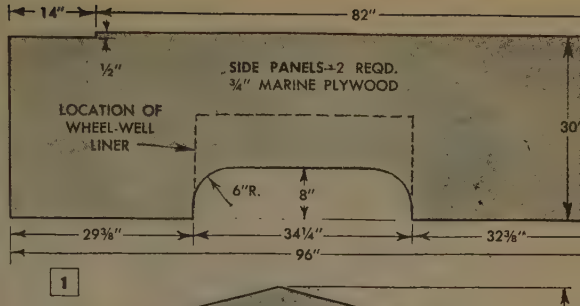
Independent of motel and restaurant, the Kendall family are enjoying camp life at its best with their trailer



Pipe extensions are screwed on lid supports to increase their length



Below, bolt-head studs project from lids to engage ends of pipe supports



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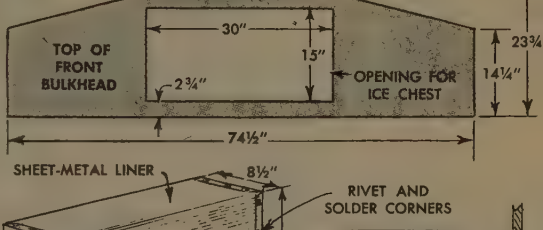
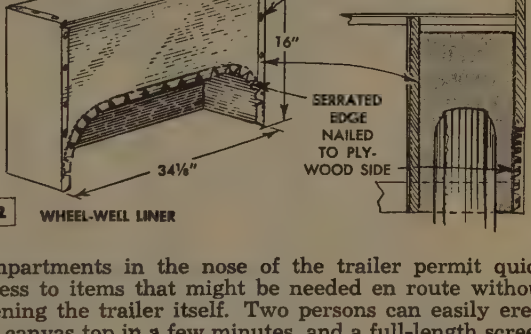


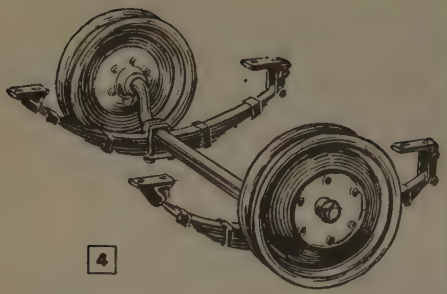


2 WHEEL-WELL LINER

compartments in the nose of the trailer permit quick access to items that might be needed en route without opening the trailer itself. Two persons can easily erect the canvas top in a few minutes, and a full-length screen door keeps flies and mosquitoes outside. The center portion of the trailer interior affords space to store an aluminum table-and-chair set, as well as a camp stove. The screen door stows away in a trap door in the floor, and built-in compartments with sliding doors provide plenty of room for cooking utensils, bedding and clothing.

Down to the last nut and bolt, the trailer cost me $457.31 to build. However, we later found we could have saved as much as $30 on the cost of the canvas top ($133) by having the awning makers sew it together during their slack season. If materials can be salvaged and a second-hand running gear purchased, the cost can be reduced considerably.

I made the bed of the trailer body from lengths of 3-in. channel iron and 1-in. angle iron, and welded the 18 separate pieces into a rigid framework. The channel stock is used for the main members of the bed and the tongue, these parts being shaded in the plan drawing, Fig. 5. Note that the forward ends of the two center members are cut at a 13-deg. angle to match the slant of the two front members of the bed. I laid out the members squarely on my garage floor to assure a flat assembly when welding the joints. The various members are placed in position with the flat side of the channel facing outward. The two center channels are spaced 36 in. apart and butt-welded to the front and rear members. Two short lengths of channel, 16¾ in. long, are butt-welded to the center members on each side of the bed to form the wheel wells.



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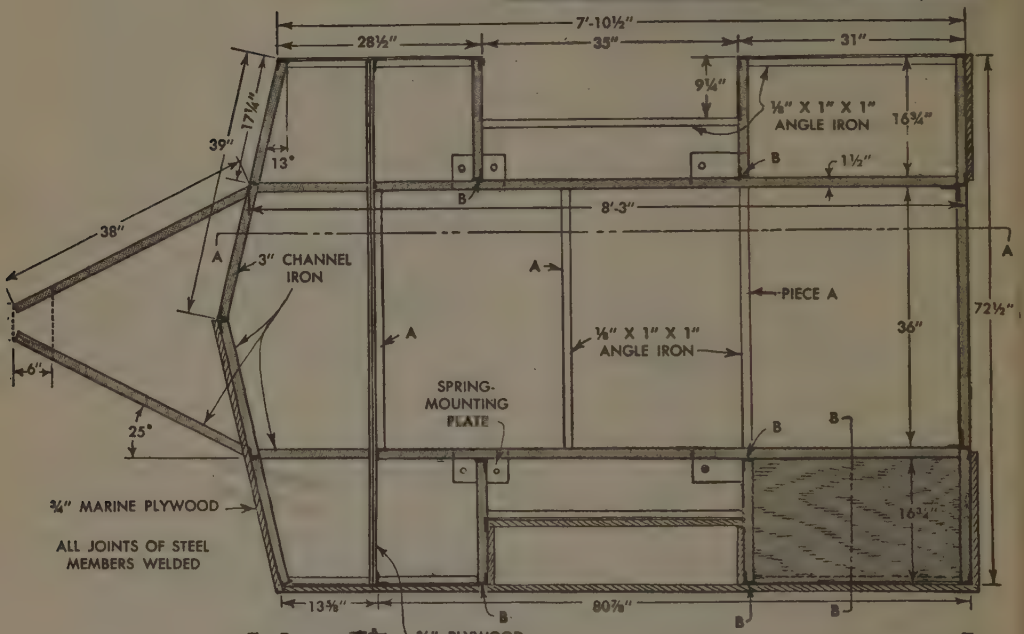
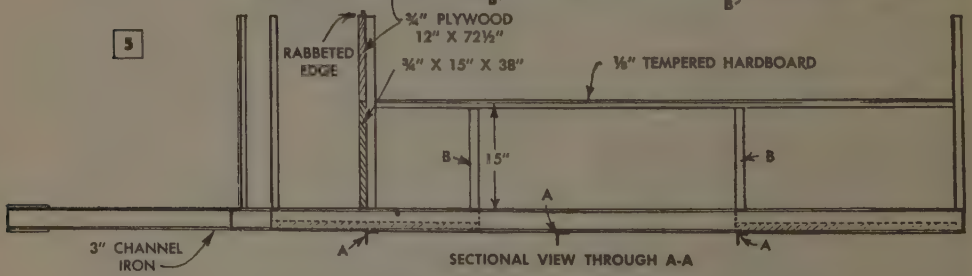
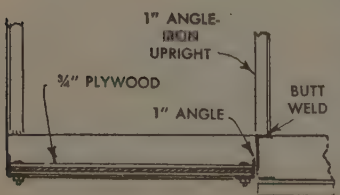


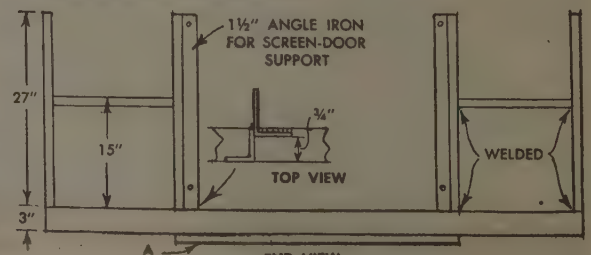


5

SECTIONAL VIEW THROUGH A-A

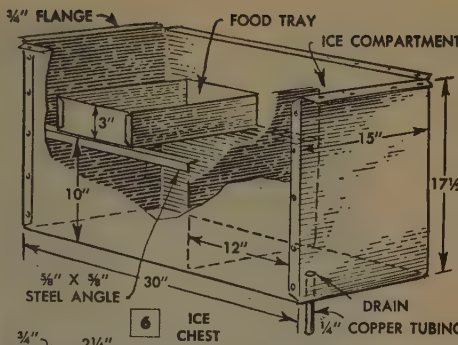


SECTIONAL DETAIL THROUGH B-B

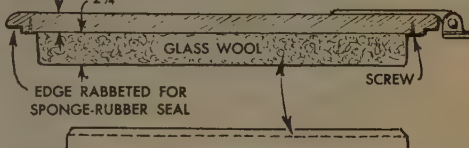


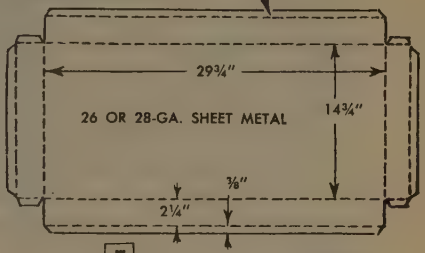
END VIEW

Weather stripping provides a seal for ice-box cover



6 ICE CHEST





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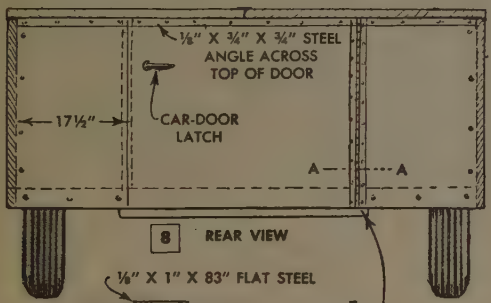
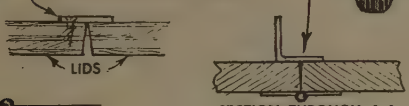
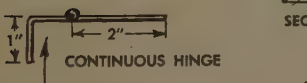
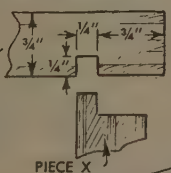
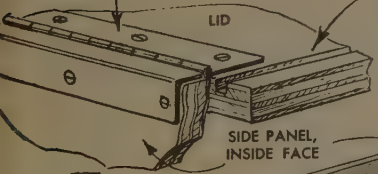


8 REAR VIEW









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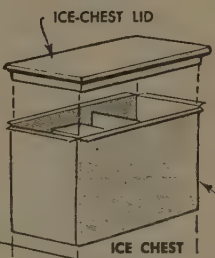
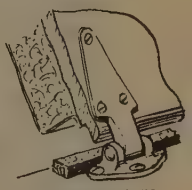
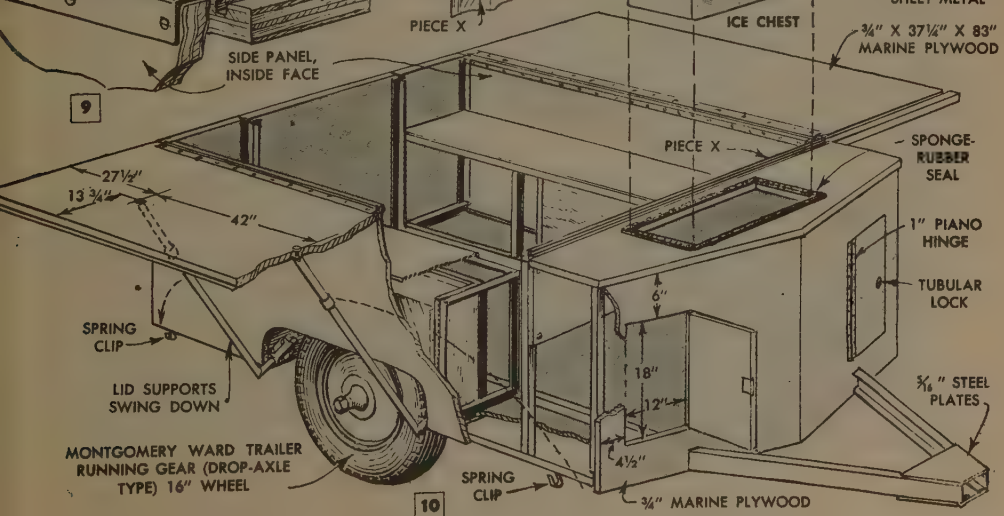




26-GA. GALVANIZED SHEET METAL

¾" X 37¼" X 83" MARINE PLYWOOD



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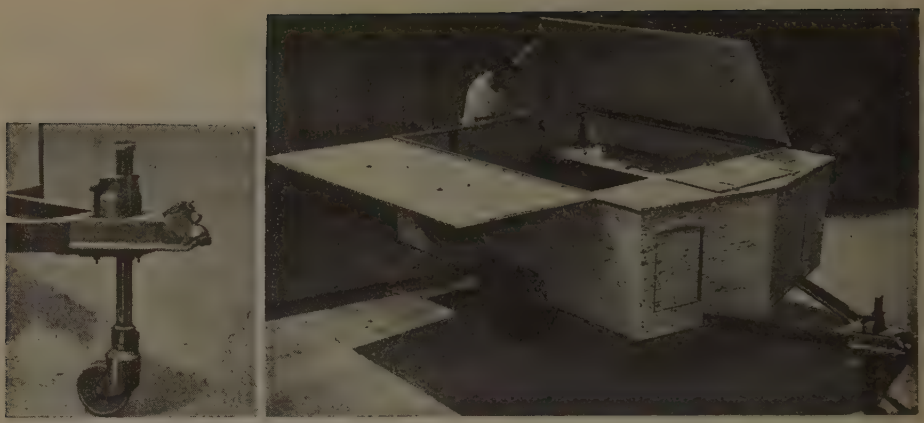


I used an Atwood commercial trailer hitch that bolts to the channel-iron tongue. Hitch permits easy rolling

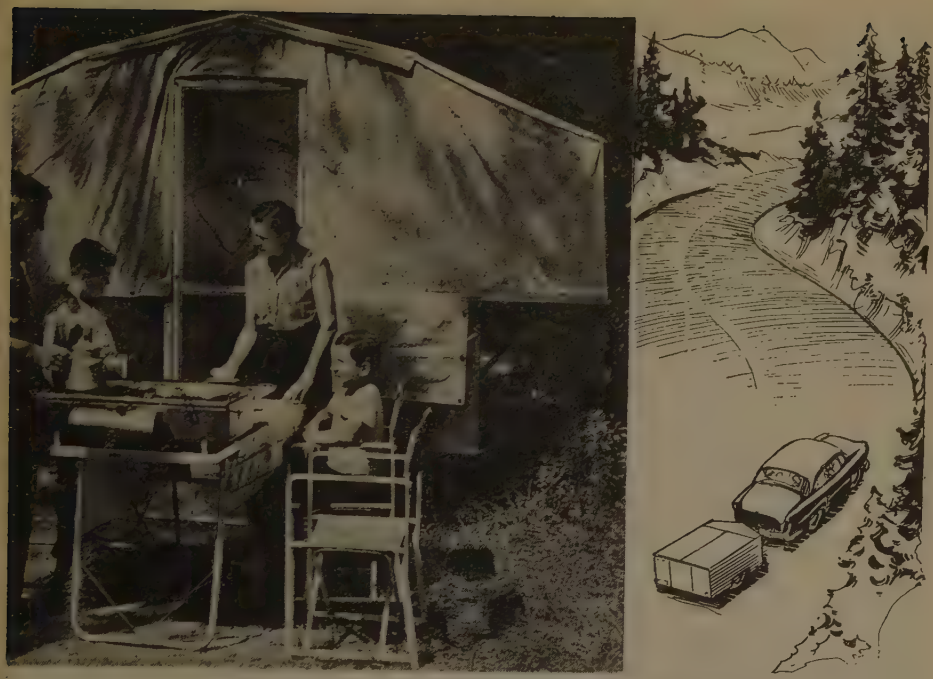
Three pieces of angle iron, marked A on the drawing, are cut 39 in. long and welded to the underside of the two center channels. These pieces provide support for a ⅜-in. plywood floor. Lengths of angle iron also are welded along the center channels and along the outer edges of the bed at the sides as indicated in section B-B, Fig. 5.

You can use any suitable two-wheel running gear, Fig. 4. I purchased a 58-in., drop-axle type having 16-in. wheels from Montgomery Ward for about $60. Spring-mounting plates, ⅜ x 6 x 8 in., are welded to the bed on the underside at the points shown and drilled for the shackle bolts.

The locations of the angle-iron posts to which the sides of the body are bolted, are spotted on the plan drawing. These are cut from 1-in. angle iron. A total of 24 are needed, ten of these being 27 in. long, two 29 in. long and twelve 14 in. long, the latter ones being located at the wheel wells, B in Fig. 5. All posts are merely butt-welded on end at their respective locations. If you study the plan carefully, you can see the way each post faces. Holes for bolting the plywood sides to the posts should be spotted and drilled before the posts are welded in place. Drill six holes for 5/16 x 1¼-in. carriage bolts in each 27-in. post, spacing them about 5 in. apart. The two 29-in. posts are butt-welded to the edge of the 1-in. angles along the sides 13⅝ in. back from the front corner posts. These particular posts support the plywood bulkhead, marked X in Fig. 10. Note that this piece is rabbeted along the top edge to engage a groove on the underside of each trailer lid to give a watertight joint. Looking at the end view, Fig. 5, you'll notice that the 1-in. posts at the rear-door opening have a second post of 1½-in. angle iron welded to them. These are set in ¾ in. and provide a bolting surface for attaching the frame of the screen door to be described later. Finally, lengths of 1-in. angle iron are welded across the tops of the 14-in. posts and between the posts at the rear of the bed. Study section A-A, Fig. 5, and the end view. These members form a shelf on each side which is covered with hardboard.

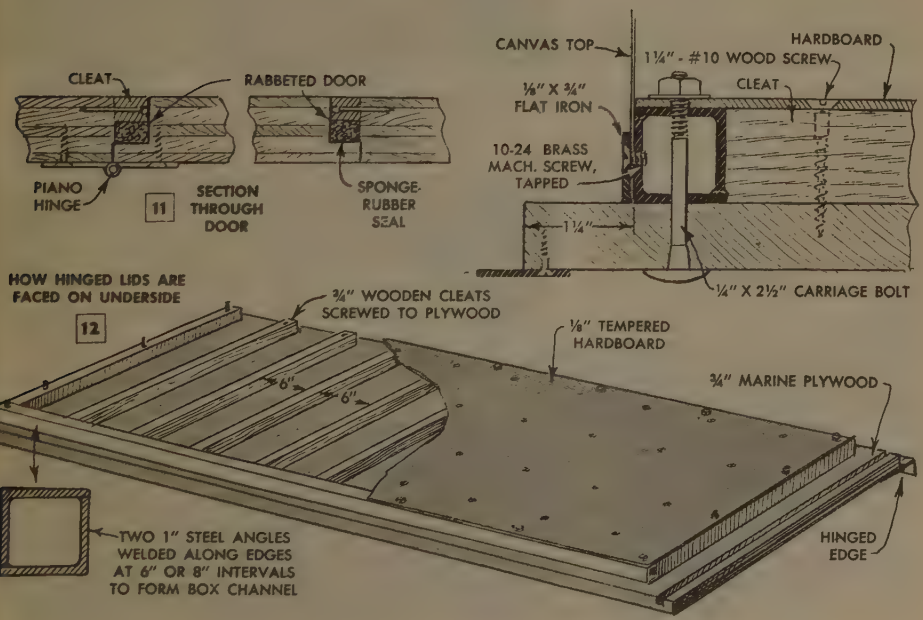
The outside is covered with ¾-in. marine plywood. Figs. 1, 8 and 10 give the sizes for the various panels. Exact lengths should be taken directly from the trailer bed, adding ¾ in. to the length of the side panels to lap the plywood applied to the back. Before the side panels are permanently bolted in place, the wheel wells first are lined with plywood and then fitted with a sheet-metal liner. This is soldered and riveted as in Fig. 2, the cut-out edge being serrated to form tabs for nailing the liner to the edge of the plywood side panel.

Figs. 6 and 7 detail the ice chest and its cover. You'll notice that the plywood part of the cover is rabbeted around the edges to bear against a length of sponge-rubber weather stripping applied around the opening in the bulkhead cover board. Standard ice-chest hardware is used to hinge the cover and provide a positive seal. The ice chest itself hangs in the opening by flanges, and glass-wool insulation is packed solidly around it. The lids, or doors, which overhang the sides when the trailer is open, are hinged with lengths of 4-in. continuous hinge which I bent in a sheet-metal brake, as indicated in Fig. 9. I could buy this hinge only in 6-ft. lengths so I made up the difference by adding a section to it. Fig. 3 shows how the pipe supports for the lids are installed. These pivot in brackets located in the wheel wells and swing up from spring clamps to engage bolt-head studs projecting from the top surface of the lids. Pipe extensions are stowed separately.



Compact as it is, Kendall's trailer has room for stowing table-and-chair set, stove and cooking utensils

HOUSE TRAILER

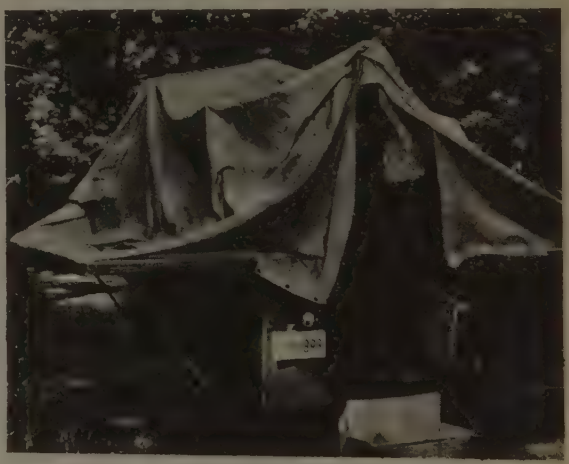


WITH construction completed to the point discussed last month, your next step is to add the framework to the underside of the trailer lids. This framework serves primarily as an anchor point to which the tent is permanently attached along each side. In studying Fig. 12, you'll notice that the framework consists of box channel on three sides over which tempered hardboard is applied and supported every 6 in. by wooden cleats. I made the box channel by placing two lengths of 1-in. angle iron together as shown and welding them along the edges at intervals of 6 to 8 in. The channel is bolted to the plywood lids approximately 1¼ in. in from the edge all around, using ¼-in. carriage bolts long enough to also pass through the hardboard covering. Holes spaced about 8 in. apart are drilled and tapped in the outer faces of the box channel. These receive small machine screws which are used to fasten flat-iron, canvas-clamping strips to the channel. Flat-headed 1¼-in. wood screws are used to fasten the hardboard to the cleats and the cleats to the plywood trailer lids.

With this step completed, you can turn to making the two folding platforms which are used to increase the width of the trailer lids so that standard 54-in. air mattresses can be used. Fig. 13 details the construction of the platforms and shows how they rest on the built-in seats when in use. They are made of ¾-in. plywood and have three legs which are hinged to fold flat. Note that the top board overhangs at the rear so it can rest on the trailer lid and be flush with the hardboard. A suitable groove is run on the underside of the overhang to allow it to fit over the barrel of the continuous hinge supporting the lid. Over-all measurements of the platforms should allow clearance for the lugs to which the tent bracing is pivoted. The links which hold the legs open are made from short lengths of flat metal. When folded flat, the platforms are stowed on the seats. In rainy weather this makes it possible to still use the seats when eating inside the trailer.

Space under the seats on each side of the wheel wells is converted to storage compartments and fitted

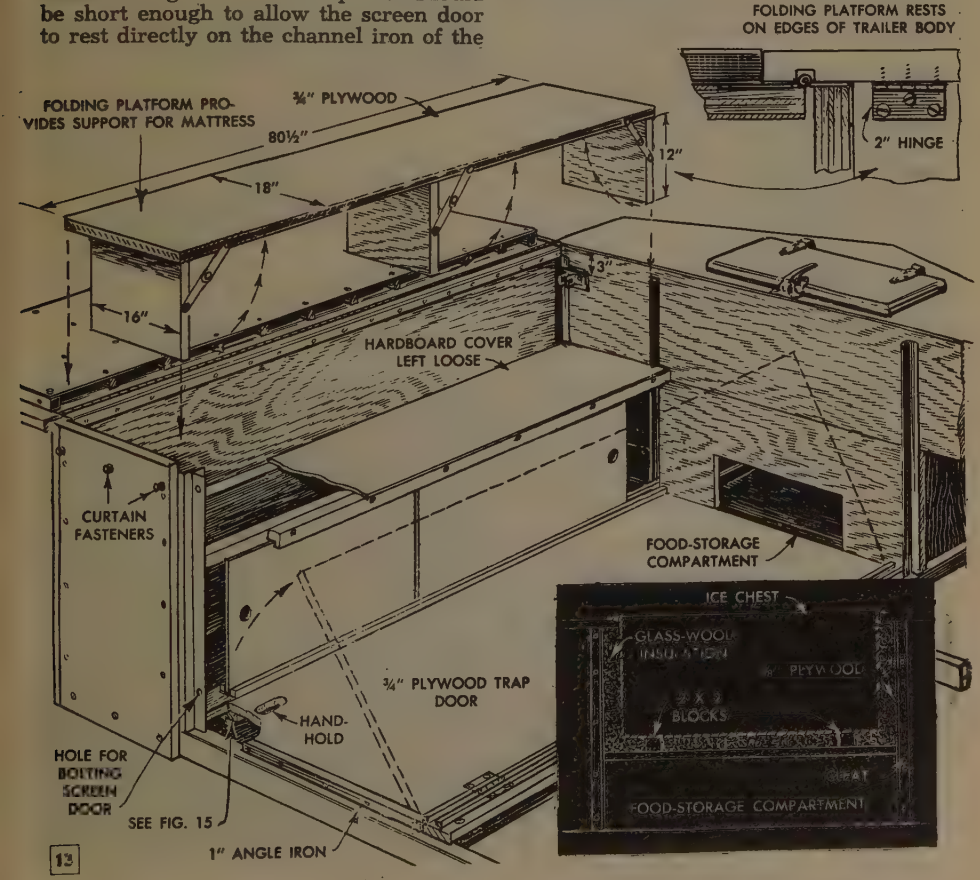
To set up camp, wings of trailer to which tent is attached are first opened outward and supported by fold-away pipe braces



Above, pipe framework swings upward from trailer body to support tent roof like covered wagon. Steps under body keep trailer from tipping. Below, Jim Kendall buttons canvas to row of regular curtain fasteners which are added to front of trailer

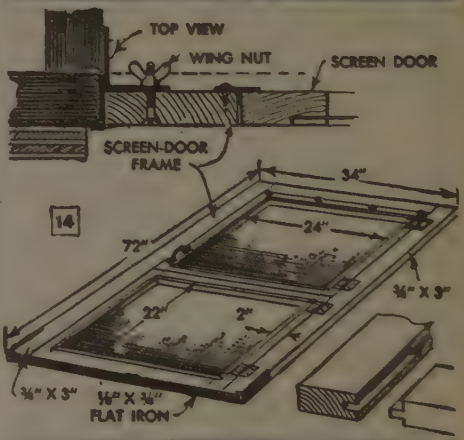
with sliding doors of tempered hardboard. The cross-section view in Fig. 15 shows how tracks are made for the sliding doors. The upper track is formed by a rabbeted strip which is bolted to the face of the angle-iron seat rail, flush with the top. The lower track is formed by two ¼-in. cleats nailed to a ¾ x 2¼-in. strip which is bolted to a channel member of the trailer bed. The ¼-in. cleats are lined up, of course, with the rabbet directly above. The ⅜-in. rabbet allows ample clearance for the two sliding doors so that any subsequent swelling will not cause them to bind. Handles are formed by boring a 1-in. finger hole in opposite ends of the hardboard panels. Stops for the hinged trap door in the floor, which affords access to a storage well below it, are bolted to the underside of the wooden channel strips. The stops run the full length of the door and you'll note that one edge of each one is rabbeted to fit over the edge of the iron channel. The trap door itself, below which the screen door is stored, is hinged along one side, the hinges being set flush so they will not interfere with the hardboard sliding doors. The trap door should be short enough to allow the screen door to rest directly on the channel iron of the trailer bed when the door is set up. A handhold is cut in the lower left-hand corner of the door for easy lifting.

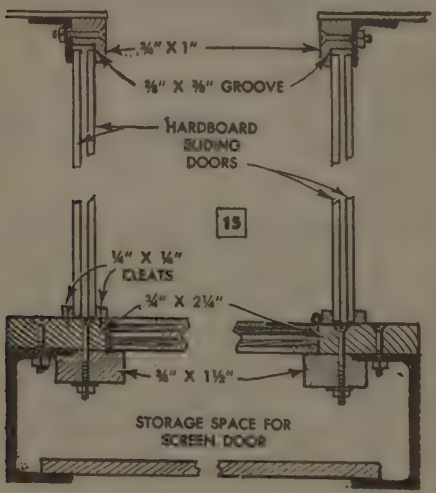
I made the screen door in one piece as you can see in the photo on the opposite page, although I since have converted it into a Dutch-type door as detailed in Fig. 14. This proved more convenient in that the door of the trailer itself could be closed and yet allow the upper part of the screen door to be opened independent of the lower section. The 3-piece frame for the door is made of ¾ x 3-in. hardwood. I used mortise-and-tenon joints at the upper corners and braced them on each side with flat-iron mending plates. These corners could be doweled or held with corrugated fasteners. The doorframe is braced across the bottom with a flat-iron strip which I bent at right angles to extend up the sides of the frame, flush. Note that the upper section of the screen door is fitted with regular curtain fasteners to permit buttoning a canvas flap across the top. Curtain fasteners also are added to the doorframe, one on each side, in line with those previ-

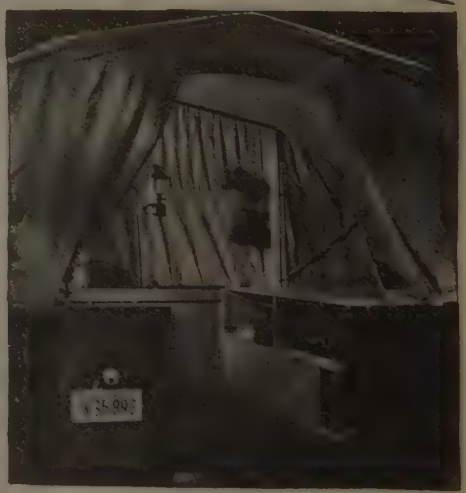


Above, screen-door unit bolts to door opening and tent flaps button to doorframe. Right, screen-door unit stores in well under trap door in trailer floor

ously added to the trailer body for buttoning the tent top. The screen-door unit, which is installed after the tent top is erected, is held securely by four flat-headed stove bolts fitted with wing nuts. Holes for these are made in the doorframe to correspond with the holes previously drilled in the angle-iron pieces to which the frame is bolted. The top-view detail in Fig. 14 shows the wing nuts on the inside so they will not interfere with closing the trailer door. The handle for the screen door is attached to the upper section so it clears the trailer door when the latter is closed.



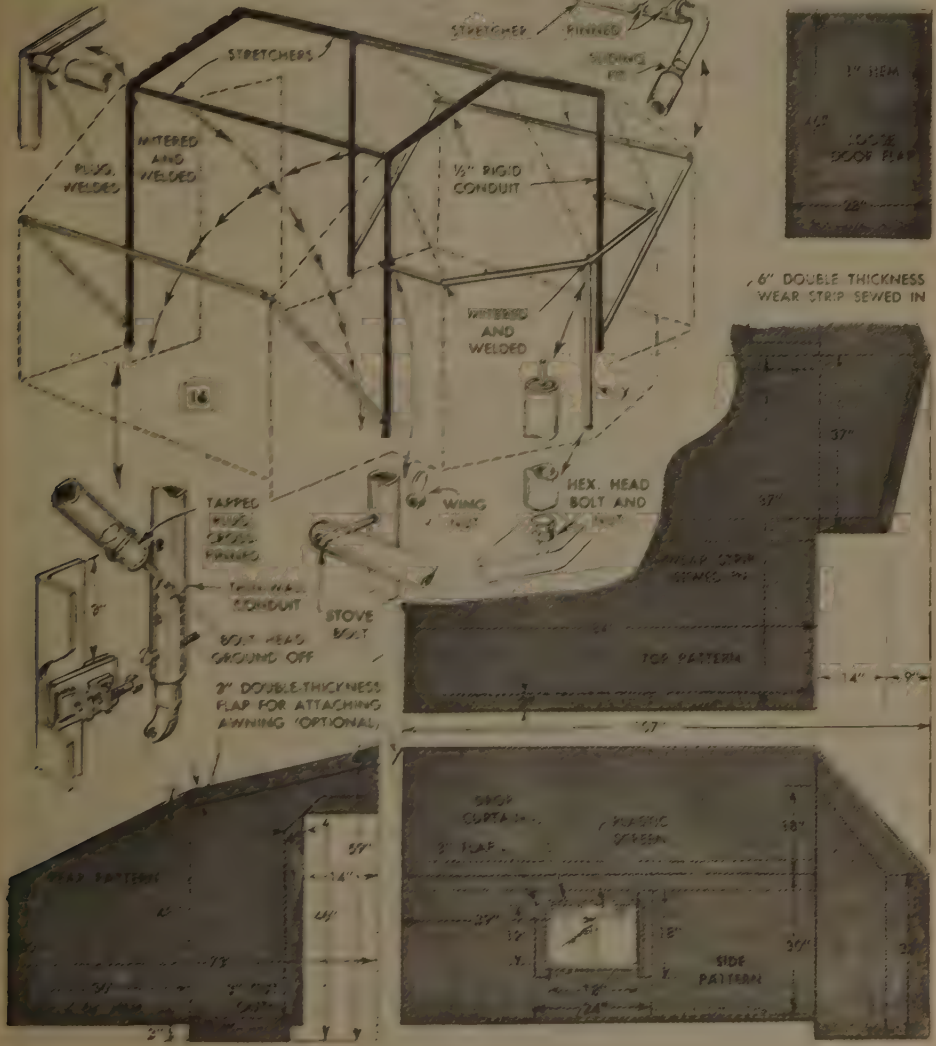




Left, drop-curtain tent window, which any awning maker can add, is installed on each side of trailer

Fig. 11 shows how I sealed the two access doors in the nose of the trailer with sponge rubber to make the storage compartments dust and water tight. Rabbeted edges around both door and door opening provide space for the rubber which is cemented to the cleats that form the inner rabbet. In closing, the door compresses the sponge rubber and seals the joint tightly.

This brings you to the tent and its supporting pipe framework. Except for the two main units of the framework which are shown red in Fig. 16 and which are perma-



Lock-fitted, rubber-sealed doors to storage compartments in nose of trailer are hinged with piano hinges

nently attached to the trailer body, all supporting members are designed to come apart to facilitate storing. The two main units are pivoted in welded angle-iron brackets bolted to the trailer body and fold flat. You'll notice here that height adjustment is provided to take up any slack in the canvas. I made the whole framework of rigid and thin-wall electrical conduit. The bows which stretch the sides of the tent, are fitted with pins in the ends to engage holes in the lower ends of the main supporting bows. Note that these side bows are made to come apart in three pieces. Pipe X serves as a prop to support the one-piece front bow. The lower end sets over a bolt-head stud in the trailer body, while the upper end has a pin to pass through a hole at the mitered joint.

In erecting the tent top, the main bows are swung up in position first, and then the three stretcher pipes are put in place over welded studs. Usually, there is enough play in the canvas top to permit the stretchers to be forced over the studs. Exact lengths of the various members that make up the framework are best determined from the actual tent itself as the over-all size of the tent will vary somewhat in each individual case.

Patterns for the tent accompany Fig. 16. I had this sewed together by an awning maker and suggest that you do, too. They know how to add the drop-curtain windows and are equipped to install the grommets for buttoning the tent to the trailer. The 3-in. flap indicated across the top of the rear pattern is optional. I had this sewed in at the time, as I plan to add a canvas canopy, supported by tent poles, over the door. The flap will provide a means of buttoning the canopy. ★ ★ ★

HOUSE TRAILER

DESIGNED expressly for the owner of a small pick-up truck who likes to get in all the fishing or hunting possible over a week end, this pickaback house trailer is "ready to go" on a moment's notice. As soon as you're through for the day, slip the trailer into the truck bed, and you're all set to head for that favorite lake or trout stream. The trailer includes all the accessories necessary for real comfort, such as storage lockers for food and clothing, gas stove and supply tank, toilet and bed.

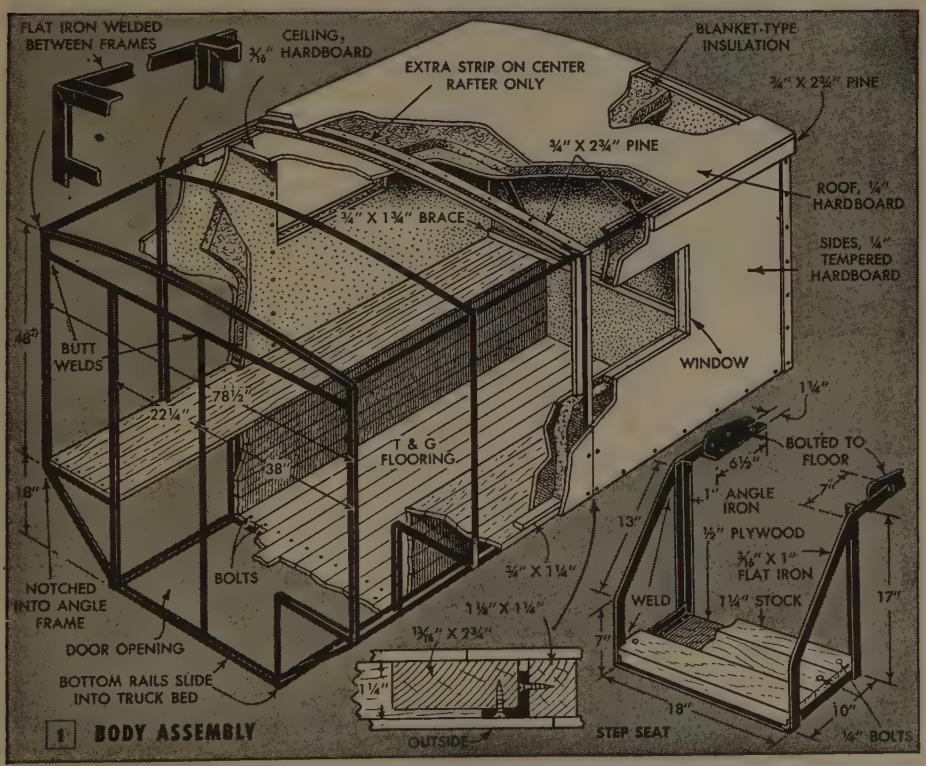
Dimensions of the center section allow 66 in. of headroom. Of course, by simply lengthening the frame uprights it is possible to increase the headroom to 72 in. or more, but the proportions of length and width to height would lack the symmetry of the original design. Also, any increase in the over-all height would make the unit less adaptable to travel on narrow roads or trails in the back country.

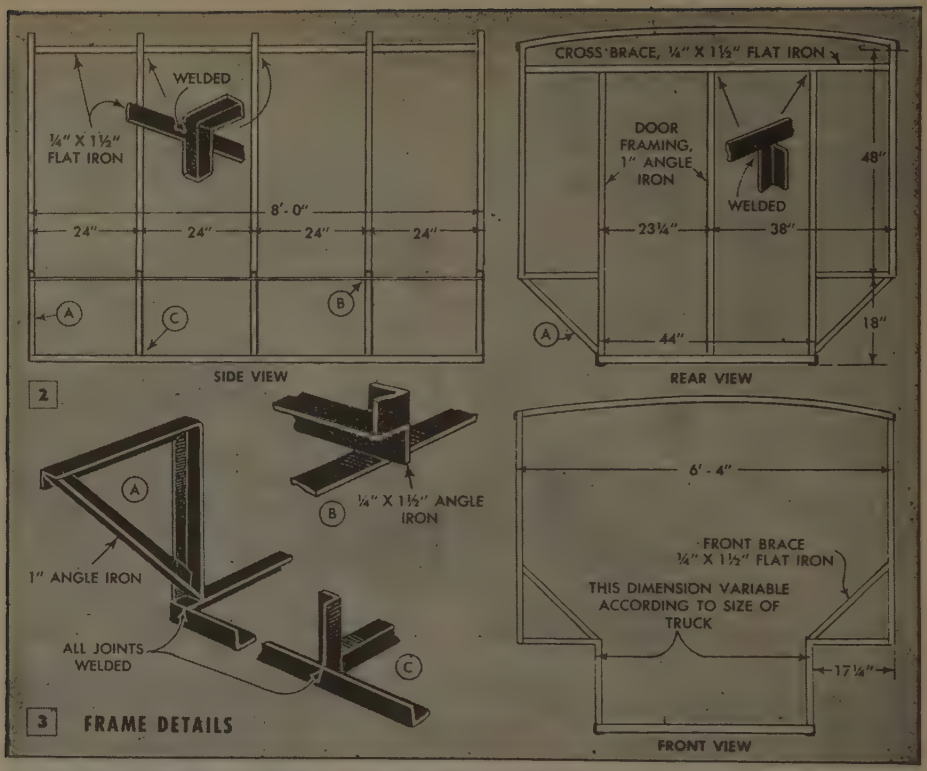
You get a good idea of the construction from the cutaway view in Fig. 1. Note that the walls and ceiling are of approved trailer-type construction with a blanket-type insulation between inner and outer wall coverings. Note also how the floor is offset at the sides to form a ledge, or seat, at each side of the center section. Because of variations in the size of the bed on various makes of pick-up trucks, some of the dimensions given in the details may have to be altered to fit the truck bed. Be sure to take careful measurements of the width, length and the height of the sides of your truck bed before cutting any materials. When finished, the body frame should slide easily in and out of the truck bed without binding at any point.

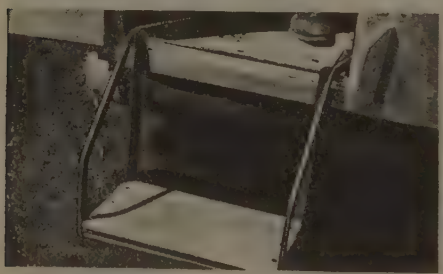
The frame is made of welded angle iron and consists of five vertical members joined across the top by carlins, or rafters, curved to a 3-in. crown. Spaced on 24-in. centers, the five frames give an over-all length of just over 8 ft. As you will see from study of the details and the accompanying photos, the frames are joined longitudinally at the bottom corners by 1½-in. angle-iron rails, detail C in Fig. 2, which serve as stiffeners and also as sills, or runners, for sliding the unit on and off the truck bed. At the upper corners, ¼ x 1½-in. flat-iron strips are butt-welded to the frames, upper left-hand detail in Fig. 1. Note that each frame is welded as a separate unit before welding

"saddle up"

enjoy life







Above, novel step-seat folds inside to form a comfortable seat, thus making use of all available space. Below, underneath view of body offset and the angle-iron framing which fits inside the bed of the truck

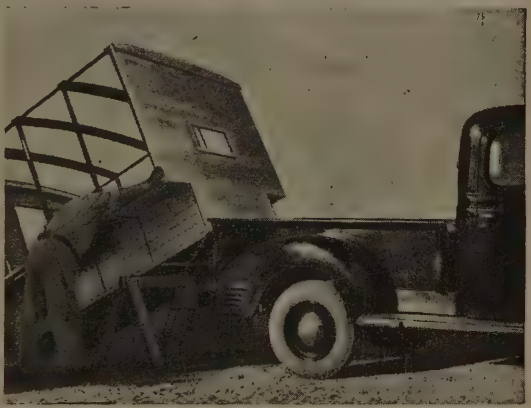
on the bottom rails and the flat-iron strips, or plates. In welding the frames, the bottom U-shaped member is made by bending A-frames from angle iron, V-notching one leg at the point where the bend will come. Then, after bending, the meeting edges are welded. The A-frames are welded to the bottom crossrails and the uprights are butt-welded to the outer ends. Then the curved carlin, or rafter, is welded in place to finish the individual frame. Care must be taken in welding to get frames of a uniform size. Use of a welding jig will assure uniformity. If the builder is not an experienced welder, it will pay to have all welding done by a professional. Now, note that a flat-iron strip is welded to the A-frames under the overhang on both sides, detail B in Fig. 2. These strips run the full length of the body frame and serve the dual purpose of making the frame more rigid and at the same time providing a convenient rack for lashing a tent, tarpaulin or other extra equipment for some special purpose. Two extra uprights and one full-width horizontal member make the door frame as shown in Figs. 1 and 2. The uprights are of 1-in. angle iron and the cross member is of flat iron, as indicated in the rear view, Fig. 2. Also, two

diagonal angle-iron braces are welded across the A-members of the back frame, detail A in Figs. 1 and 2. Note especially that the same braces at the front of the frame are placed above the overhang as in the front view, Fig. 3, and that flat iron is used instead of angle. It is necessary that the front braces be placed in this position to prevent interference when loading the body onto the truck bed.

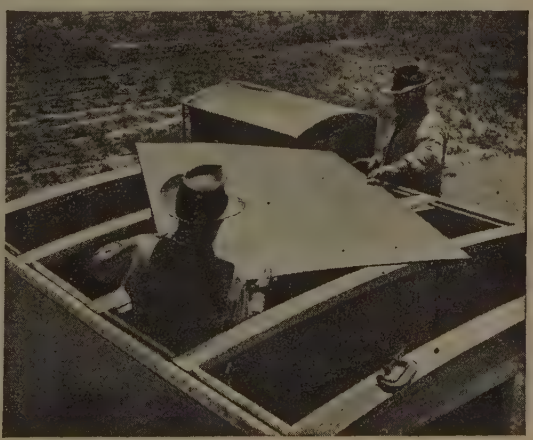
After all metal parts of the frame have been welded together to form a unit, the next step is to install the tongue-and-groove flooring. Lay the center section first, and then carry the flooring up the vertical sides and across the overhang on each side as in Fig. 1. Because of the metal "joists" the flooring must be attached with 1¼-in. 8-32 machine screws with nuts and lock washers. The clearance holes for the screws are drilled through each flooring board and through the angle iron. Use one screw at each frame, drilling through the center of the board. Be sure that the boards are drawn tightly together as they are laid. It's a good idea to shellac the boards before laying to prevent absorption of moisture. Next, install the front and back panels, Fig. 4. These are cut from ½-in. waterproof plywood and are attached to the angle-iron framing with machine screws of the same size as used for the flooring. After installing the front and back panels, measure and cut an opening for the front window. This is centered in the body frame and is at the same height as the rear window in the truck cab. Note also the position of the rear windows, one in the door and the other in the body panel, rear view in Fig. 4. These three are unit sash and are not adjustable. Placing the sash in this position enables the driver to see the road through the rear-view mirror in the truck cab. However, as an added precaution it's a good idea to install a truck-type extension mirror on the cab.

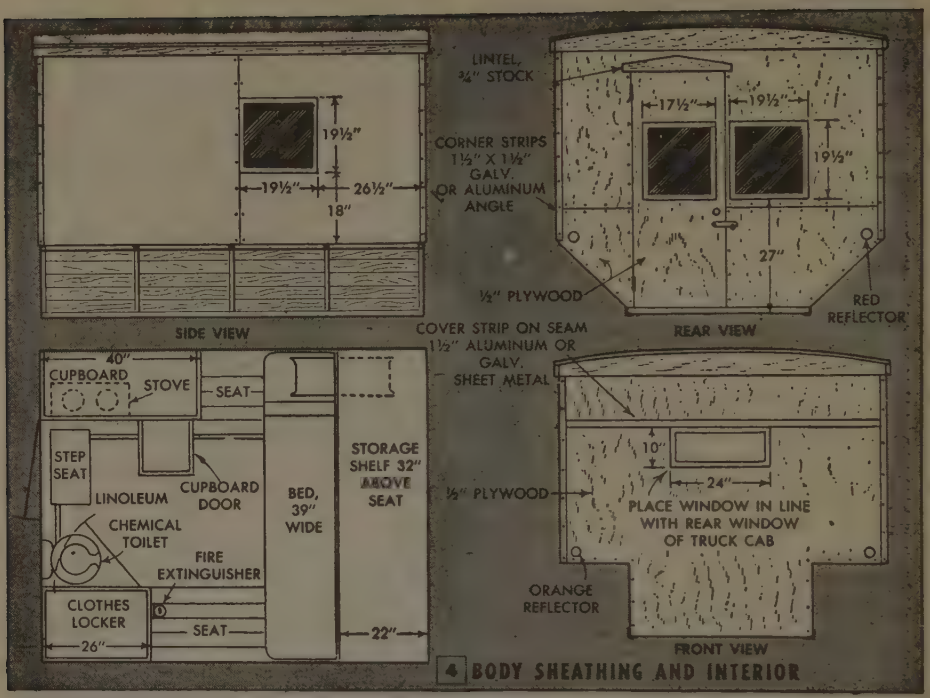
At this stage, the body frame can be loaded onto the truck for completion of the job. The first thing is to attach wooden strips to the angle-iron frame members at the sides and across the roof carlins so that the outer and inner wall panels can be screwed in

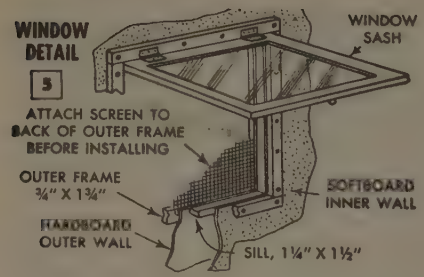
The angle-iron frame of the "pickaback" trailer body with the floor and front panel installed. Note the front window opening

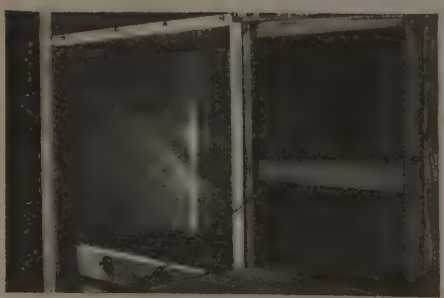


Above, loading the unit is made easy by supporting the front end on sawhorses. Below, roof carlins, or rafters, are curved to form a watershed. Rafters are faced with wooden strips









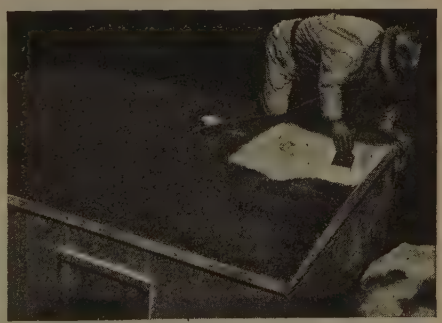
place. Note the lower center detail in Fig. 1, which shows how a wide wooden strip is attached to the center frame to back up the joint in the inner wall covering. All the other strips are attached to the front side of the frame members. Either wood screws or machine screws with nuts can be used to attach the wooden strips to the angle-iron uprights. The wooden roof strips are centered over the curved carlins. Next, attach the side panels which are cut from ¼-in. tempered hardboard. The joint on both sides is made over the center upright as in the side view, Fig. 4. It should be set in waterproof glue and fastened with two rows of screws which are equally spaced 4 to 6 in. apart. Now, attach the trim strips, or nailing strips, across the front and back and the sides as in the side, rear and front views in Fig. 4. Note that the front and back strips are bandsawed to the curve of the roof carlins. The top edges of the side pieces are beveled to meet the curve of the carlins to get a smooth, tight joint between the sides and the roof covering. The top panels also

are of ¼-in. tempered hardboard and are joined on the center carlin. Use waterproof glue in all the joints and fasten with flat-headed wood screws equally spaced in straight rows. Allow the top panels to project 1/16 to ⅛ in. all around to allow for inequalities in fitting. The projections are planed flush after the roof is finished. Finally, the four aluminum angles are attached. These protect the corners of the body and help to prevent leaks.

Next, cut openings for the side windows, Figs. 4 and 5, and you're ready to finish the interior. Nail in ¾ x 1¼-in. strips to form sills as in Fig. 1, then apply insulating material to the walls and ceilings. Cover walls and ceilings with 3/16-in. softboard, or birch plywood of approximately the same thickness. Use cup washers and oval-headed screws for attaching the interior finish. Fig. 5 details the window framing. Only the side-window sashes are hinged; the others are stationary. On the side windows, screen wire is attached to the inner side of the outer frame, or casing, before it is screwed in place. The hinged sashes are held open by a light chain attached to the ceiling with a screw eye. Trailer-type window units also can be used instead of the type detailed in Fig. 5. These are furnished as a unit complete with screen and metal frame ready to install in the window opening. Lintels over the windows and door are cut from ¾-in. stock and the top edges are beveled to form a watershed. The parts are attached to the framing with screws.

The back door is a simple unit made from waterproof plywood. This is hinged to swing outward and is provided with a night latch. The novel step-seat, Fig. 1 and the photo below Fig. 3, provides not only a handy rear step but an extra seat when folded inside. The frame of the step is built up by bending and welding angles and flat iron together to form the supporting frame as in the lower right-hand detail, Fig. 1. The short angles to which the step is pivoted are shaped as shown by sawing and filing and are bolted to the floor of the center section. They must be located so that when the step is folded outward the vertical members of the frame will bear against the outer edge of the doorsill as in the photo below Fig. 3. Cover the bottom of the step—this forms the seat when the step is folded—with ½-in. waterproof plywood.

No construction details of the interior fittings have been included, as the arrangement of the cabinets and accessories has been left to the discretion of the builder. However, the lower left-hand detail in Fig. 4 suggests a typical arrangement of the interior. If desired, the center-section floor can be covered with linoleum or rubber tile and the exposed portions of the overhang

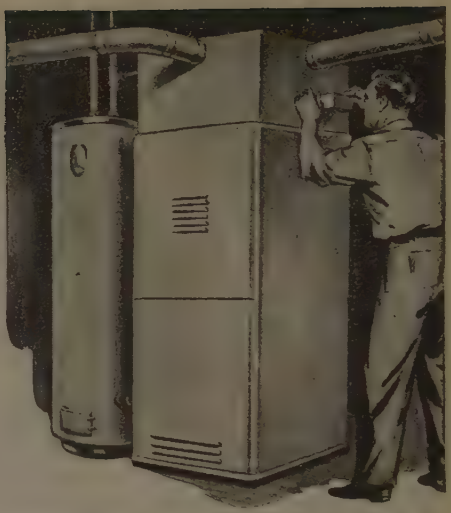


Above, top edges of the door and window lintels are beveled to form drip caps. Below, prime-coat the roof, sides and ends with one coat of aluminum paint

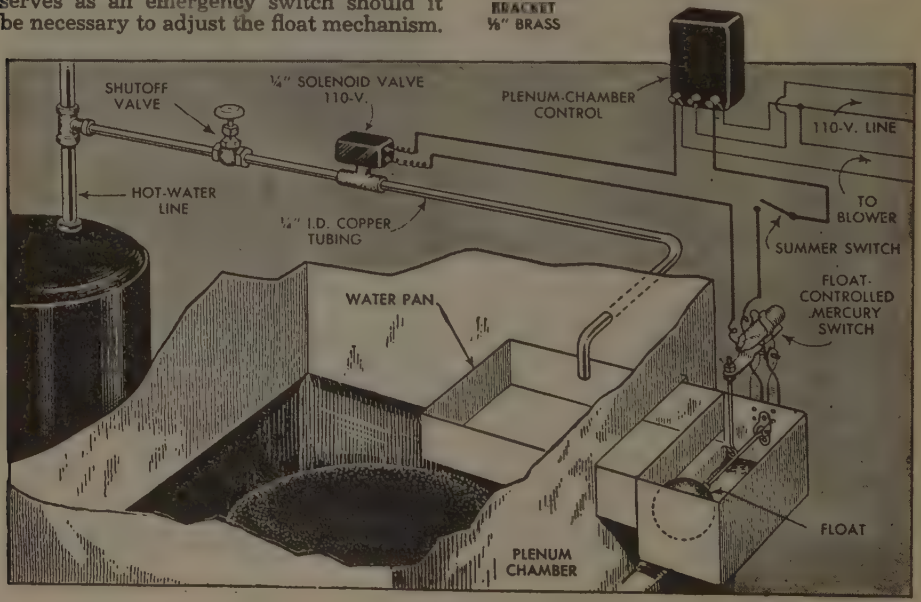
on both sides can be upholstered to form two comfortable seats. Paint the outside of the body with one coat of aluminum paint as a primer, then finish with two coats of outdoor enamel in whatever color you desire. If the inside has been finished with birch plywood, give it two coats of varnish in the natural color. The unit should be fastened in place on the truck bed by two ⅜-in. bolts passing through the floor underneath the bed and through the metal bed of the truck. Locate the bolts so that they are easily reached from the underside of the bed and use lock washers to prevent the bolts from loosening.

HUMIDIFIER CONTROL

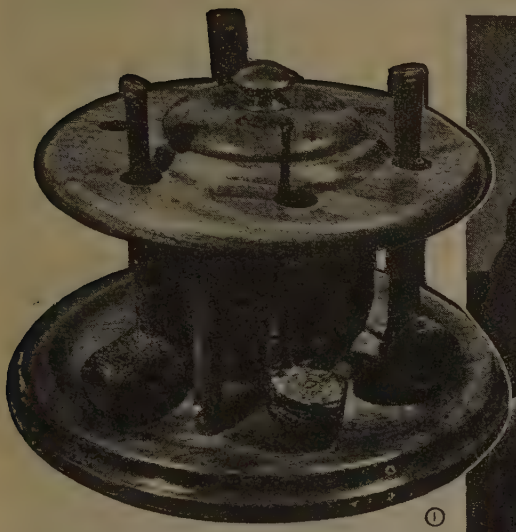
FLOAT CONTROLS on furnace humidifiers that depend solely on evaporation of water to actuate the float-controlled valve often give trouble because of sediment collecting in the valve. Since the water in the humidifier pan, or tank, evaporates slowly, the valve generally is slightly open for long periods of time, permitting water to drip. Because of this condition, sediment and lime deposits build up on the valve seat, preventing complete closure. This sometimes results in flooding. To solve this problem one homeowner designed and built the all-electric control detailed below. Power to operate the solenoid valve is taken off the blower control box by connecting leads to the terminals in the manner shown. The advantage of this type of control is that it can function only when the heating unit is in operation. Lowering of the water level in the pan closes the circuit through the mercury switch and opens the solenoid valve, permitting water to flow into the evaporating pan from the hot-water heater. When the float rises sufficiently to open the mercury switch, the solenoid valve closes tightly. This cycle continues as long as water is required in the evaporating pan. Note that the solenoid-valve circuit is provided with a summer switch, which also serves as an emergency switch should it be necessary to adjust the float mechanism.



MERCURY SWITCH
FUSE CLIP RIVETED TO BRACKET
BRACKETS, ⅛" X ¾" BRASS
TWO NUTS FOR DIFFERENTIAL ADJUSTMENT
FLOAT LINK, ⅛" BR.
BRASS HOOK SOLDERED TO ROD
RING SOLDERED TO FLOAT ARM
BRACKET ⅛" BRASS



HUMIDOR



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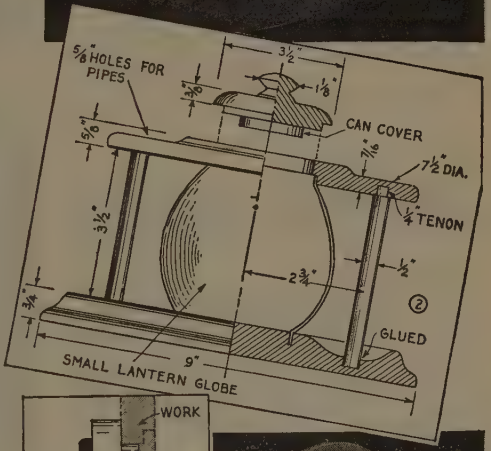
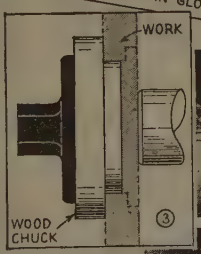
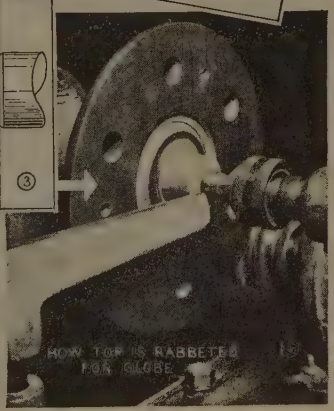






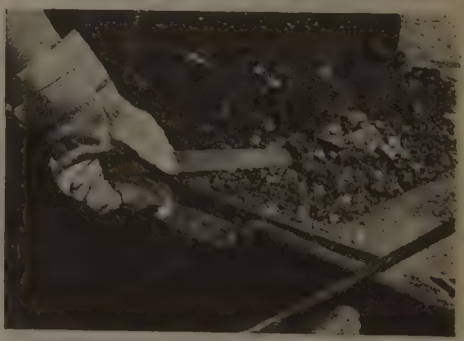
Appropriate for the discriminating pipe smoker, this combination humidor and pipe rack accommodates six or more pipes and a good supply of tobacco. The unit consists of a turned wood base and top, and a colored lantern globe, which serves as the humidor, three dowels being used to space the wood parts and hold them on the ends of the globe. Fig. 1 shows the completed unit, while Fig. 2 gives the assembly. Openings are made in the top for the pipe stems and the humidor lid. Fig. 3 shows how a wood chuck is used to hold the top disk on a faceplate. Notice that the lid opening is rabbeted on the underside to take the globe end and that the base is grooved for the same purpose. The rabbet is turned while the disk is still on the improvised chuck as in Fig. 4. The groove should be slightly oversize to prevent shrinkage of the wood from breaking the glass. The globe can be cemented in the groove if desired, although this is unnecessary if the top and base are held tightly on the globe ends by the dowels. A little melted paraffin poured in the bottom of the humidor will prevent tobacco from contacting the wood. A humidifier is provided for the tobacco, and consists of a can cover screwed to the underside of the lid and filled with plaster of paris, which is moistened with water occasionally. Either wax or shellac provides a nice finish for the wood parts of the unit.

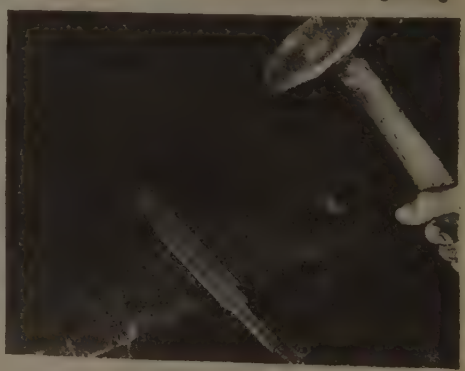
HUNTING KNIFE

WHEN PREPARING for long and difficult trips afield, hunters, trappers and explorers often discard other less essential equipment in favor of the all-purpose hunting knife. An experienced camper alone in the woods would rather lose his tent than the hunting knife in his belt sheath. He can get along without the former; the latter is indispensable.

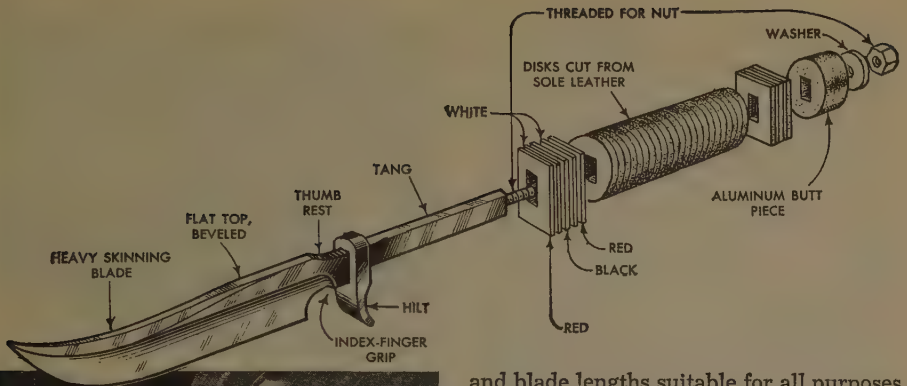
Although knifesmiths usually select Swedish steels because of their stability and extremely fine grain, for the finest hand-forged custom blades, you can make a reasonably good hunting knife from a large mill file. Probably the next best material is an oil-hardening tool steel, as it has a better response to tempering and a more uniform soundness of structure than does the average file.

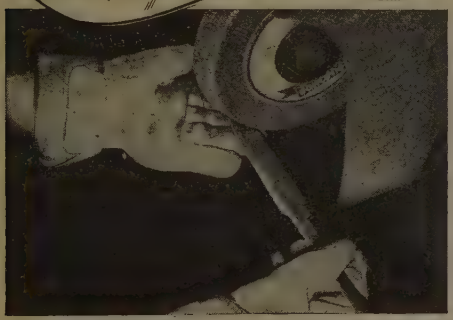
Photos on these pages showing the essential steps in knife making were taken in the workshop of W. D. Randall, noted knifesmith who began making knives as a hobby and now is in the business of hand-forging them in various styles that class among the finest made. In the photo above Randall-made knives are shown in styles



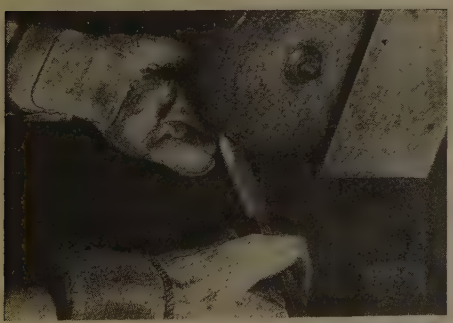


Above, one of the first steps in making a knife is heating the blank in a blacksmith's forge. Below, after heating, the blank is hammer-forged on an anvil to draw the blade to the rough form for grinding





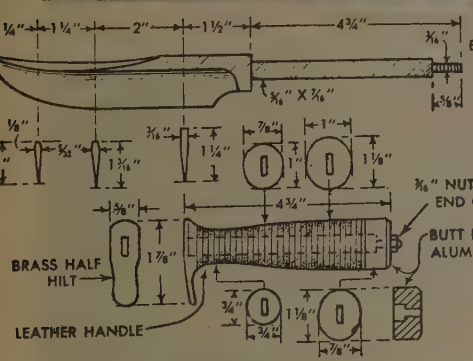
Above, rough-grinding the blank on a coarse emery wheel. Below, polishing blade on stitched cloth buff



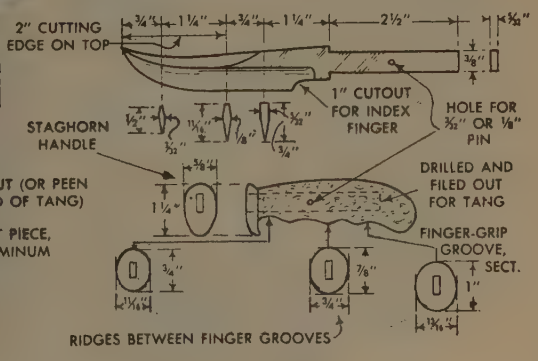
and blade lengths suitable for all purposes.

In making a blade in any of the three styles detailed below, the blank is first ground to form the tang to sectional size and to shoulder the offsets for the hilt. If a file is used, it ordinarily is annealed before grinding. Then the rough is heated to a cherry red in a blacksmith's forge (heating also can be done in a coal-burning furnace) and hammer-forged on an anvil as in the lower photo on the preceding page. Forging in this manner draws the bevels to the rough shape and gives an edge thickness of about 1/32 in. Then the blade and tang are finished to exact size by freehand grinding on a coarse wheel as in the upper photo at the left. The edge bevels are ground to form a cutting edge and the narrow back bevels are ground in to shape the blade to contour. This operation requires extreme care to get the lines of the blade ground true. Note that in the photo the operator is wearing heavy leather gloves to protect his hands from injury. He also wears industrial-type goggles.

Next the blade is hardened by heating it cherry red and immersing instantly in tempering oil. On some steels it is necessary to repeat this process in order to equalize internal stresses. Use low heat in succeeding steps—about 450 deg. When properly



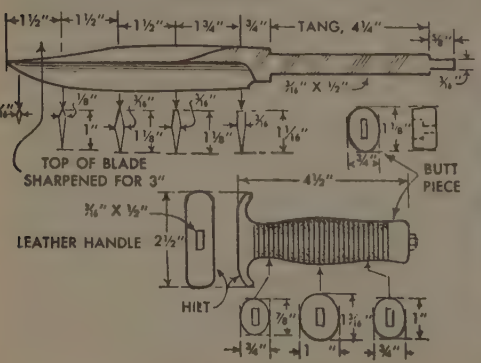
HUNTER'S KNIFE



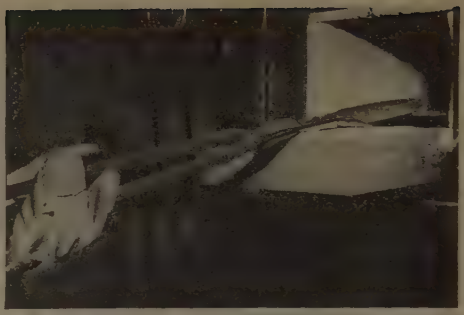
TROUT AND BIRD KNIFE

tempered the blade appears a straw-blue color and can be cut with a file. From this point on, special care must be used to avoid drawing the temper. True the bevels by slow, light grinding on a medium-fine wheel, checking the results continually by eye until all surfaces of the blade show a true reflection when viewed in oblique light. Before honing and buffing, the reflections will be rather dull, but they will enable you to spot irregularities in the surfaces. While grinding the blade to final contour, true up the tang and fit the hilt and butt piece. In the knives pictured and detailed, the hilt is of brass and the butt piece of aluminum. The hilt is filed to the rough shape before fitting to the tang. Final finishing of the blade is done on a hone as in the lower right-hand photo, and the fine scratches left by the final grinding are removed by buffing on a stitched buff as in the lower photo on the opposite page. The buff should be charged with polishing rouge of the type specified for steels.

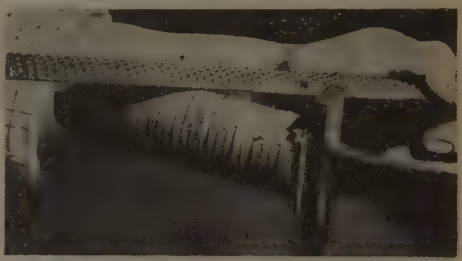
Although ivory, staghorn and even certain metals are used for handles, ordinary top-grain cowhide is recommended for hunting knives. The lower center photo at the right compares the rough with the finished leather handle. Details below and on the opposite page give sizes of the leather disks. Note that the latter are oval in rough shape and that the center holes are cut rectangular to fit the tang snugly. Five 1/16-in. fiber squares in three colors are fitted on the tang next to the hilt. Then follow with the leather disks and three or five fiber squares. Cement each disk and square to the one preceding. Then attach the butt piece firmly in place by peening the tang projection. Rough to size and shape with a coarse rasp as in the upper center photo at the right. Then finish the hilt and the entire handle with a medium emery wheel and finally bring to a high polish with a stitched cloth buff charged with polishing rouge. When buffing be careful not to heat the leather handle unduly. The shape of the handle is optional. Grind it to a form that suits your finger grip. ★ ★ ★



ALL-PURPOSE FIGHTING KNIFE



In the tempering process the blade is heated in an electric furnace which permits close control of temperatures so essential to proper tempering of steel



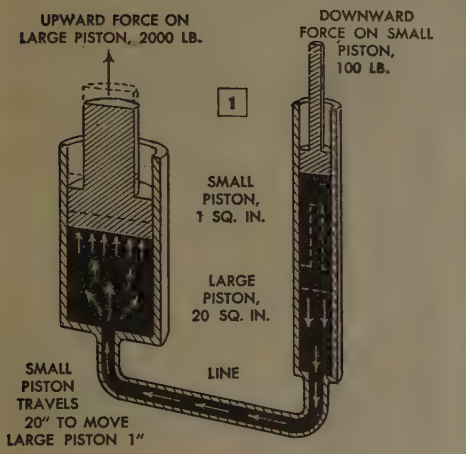
Leather handle is roughed out with a coarse rasp and the hilt and butt piece are filed to the rough shape. Finish with emery wheel and a stitched buff

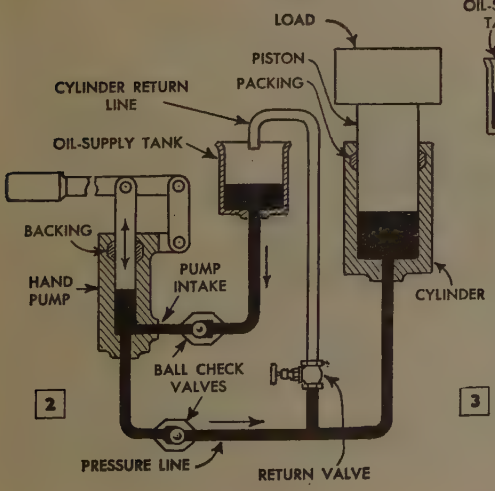
Above, the rough and finished handles of the all-purpose knife. Below, honing the blade by hand on a three-part professional-type hone. Note blade angle

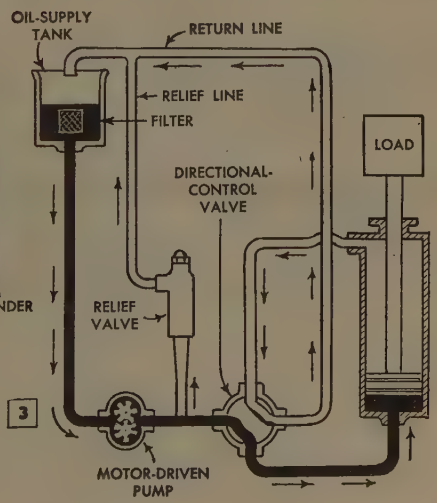
HYDRAULIC LIFT

BOTH IN INDUSTRY and on the farm hydraulically operated lift and control mechanisms are doing more and more of the hard work in handling heavy loads and in raising, lowering and depth control of heavy farm implements. Hydraulic controls also are used on various types of units designed to move earth and snow, scrape and level fields and roads, and scoop loose materials.

Using such component parts as hand and power-driven pumps, lift cylinders, control valves and flexible pressure lines, it is easy to build a hydraulic unit to do almost any kind of work desired. Although an assembled, hydraulically operated unit may appear quite complicated, the principle on which it operates is simple. The pressure applied to the fluid, usually oil, is transmitted through the various parts to every point the fluid reaches in the system. The simple system employs an assembly of hydraulic elements for accomplishing the required routing of the oil under pressure to the lift cylinders or other devices for obtaining the desired movement. There must be a pump, either hand or power-operated, for generating pressure, and flexible pressure lines for carrying the oil under pressure to the desired points. Cylinders and other units, such as fluid motors, are used to convert the energy into useful work. Valves are in-


UPWARD FORCE ON LARGE PISTON, 2000 LB.
DOWNWARD FORCE ON SMALL PISTON, 100 LB.
1
SMALL PISTON, 1 SQ. IN.
LARGE PISTON, 20 SQ. IN.
LINE
SMALL PISTON TRAVELS 20" TO MOVE LARGE PISTON 1"



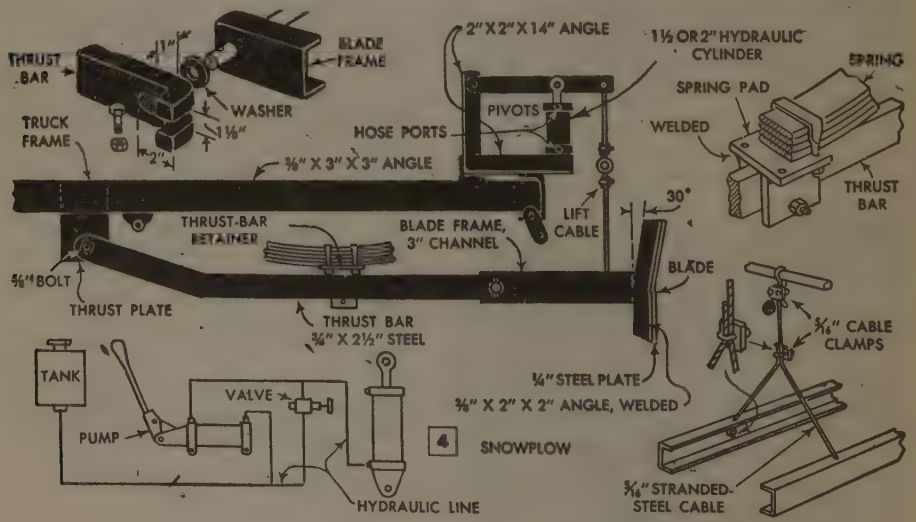


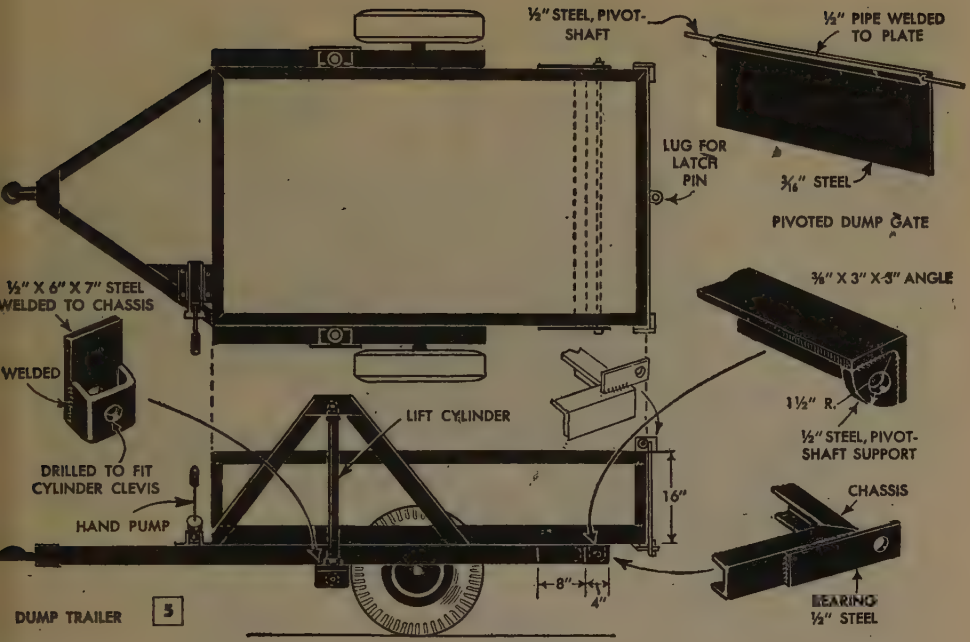
A Jeep or light truck fitted with this combination bulldozer-snowplow speeds up the job of clearing snow from driveways, feeding floors and farmyards. It also makes a fast, handy 'dozer for moving earth

stalled in the lines to control the direction of fluid flow and to limit the pressure where required.

Figs. 2 and 3 show basic types of hydraulic systems, that in Fig. 2 being hand-operated with a manually operated return valve while the more elaborate system shown in Fig. 3 employs an automatic relief valve, a directional control valve and a motor-driven pump. The basic principle on which these systems operate is shown in Fig. 1. Using this detail as an example, the application of a force of 20 lb. to the small piston, having an area of 1 sq. in., will exert a pressure on the oil below the piston of 20 lb. per sq. in. As the small cylinder is connected to the large cylinder by a pressure line, the force exerted against the bottom of the piston in the larger cylinder by the column of oil will be 20 times 10, or 200 lb., assuming that the larger piston has an area of 10 sq. in. By raising the pressures the values will be raised proportionally. If, for example, the force applied to the small piston is raised to 100 lb., then the lifting power (upward force) of the large piston will be 2000 lb. However, the important thing to keep in mind is that if the application of force to the larger piston causes it to travel 1 in., the smaller piston must travel 10 times that distance, or 10 in.

In the practical working unit in Fig. 2 the small piston is a pump fitted with a handle permitting repeated strokes. This reduces the size of the pump (smaller piston) to a point within usable limits. Check valves





Hydraulic dumping mechanism is easily installed on trailer while it is being built. Only two lift cylinders and a hand pump are required. Body and chassis of the trailer are built by welding steel angles and channels

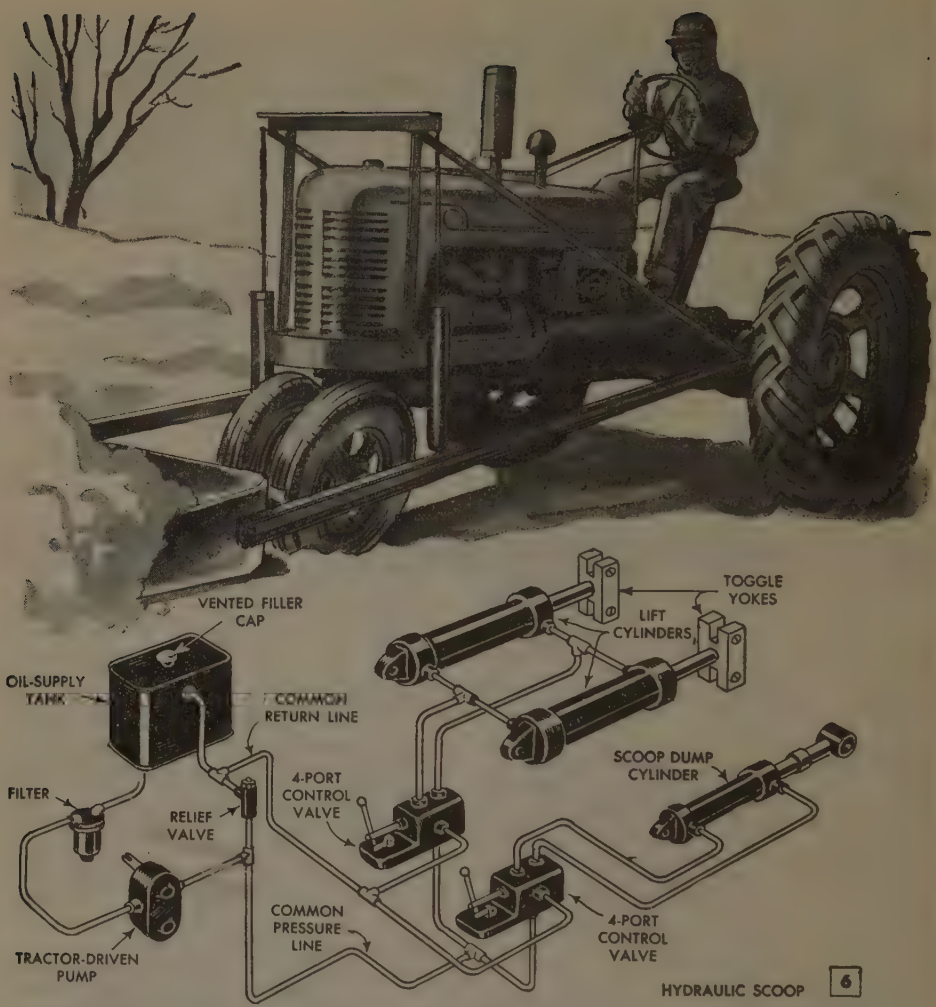
have been installed in the system to prevent the oil in the larger cylinder from returning to the smaller cylinder when the pump handle is released. The second check valve prevents the oil under pressure in the smaller cylinder from returning to the supply tank. Also, in order to make the unit workable, it is necessary to install a return valve so that oil in the larger cylinder can be returned to the supply tank when the work stroke of the larger piston has been completed.

Now note the variations in the system detailed in Fig. 3. By using a continuously rotating pump the ball check valves can be eliminated. The directional control valve is used to route oil under pressure to both ends of the lift cylinder, providing a means of exerting force in opposite directions. To protect the pump from damage by excessive pressures a relief valve releases oil from the pump outlet when pressure in the lines exceeds a given level. To protect the pump and cylinders from excessive wear a filter is installed in the supply tank to remove any abrasive material which may be present in the oil.

Note that by rotating the directional valve through 90 deg., Fig. 3, the oil under pressure will be directed to the upper end of the cylinder, forcing the piston downward. Oil below the piston remaining from a previous upward power stroke will be bypassed by the directional valve back to the supply tank. There are, of course, many variations of the valves, lines, pumps, cylinders and fluid motors used in hydraulic systems and for this reason none of these components has been shown in complete detail in the illustrations. Operating conditions generally serve as a basis for determining the types and sizes of the parts used in building and installing the system.

Typical examples of the application of the simple hydraulic system are the combination snowplow and bulldozer shown in Fig. 4 and the dump trailer, Fig. 5. Both of these units utilize the hand-operated hydraulic system detailed in Fig. 2, as the only function of the hydraulic unit is to raise the trailer body and the snowplow blade. There is sufficient weight in both the body and blade to lower the parts by gravity alone. Both hydraulic systems will be used only intermittently and, as there is no requirement for oil under continuous pressure, a hand pump will serve the purpose in both installations.

Installation of the bulldozer requires no major structural changes in a truck or Jeep. Flat-steel thrust plates are bolted or welded to the chassis frame just back of the rear-

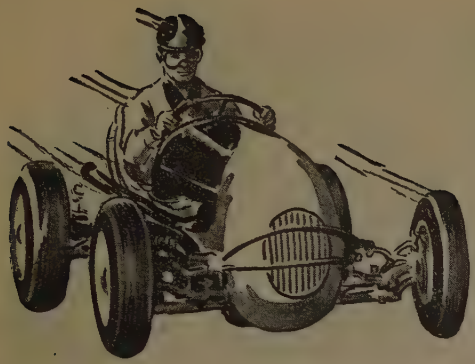


HYDRAULIC SCOOP 6

spring shackles and the thrust bars are attached to the plates with 5/8-in. bolts fitted with castle nuts. The forward ends of the thrust bars are slotted and the projections bent at right angles so that the members of the blade frame can be fastened with bolts to permit easy removal. The method of attaching these parts is shown in the upper left-hand detail in Fig. 4. The upper right-hand detail shows how the thrust bars may be attached to the spring pads. The hand pump should be bolted to the floor of the driver's compartment, or cab, in such a position that the handle is reached easily with the right hand. Also, the return valve should be located so it is within easy reach when it is desired to lower the blade. The supply tank should be mounted on a bracket at a level higher than the pump for best results.

When the unit is used as a snowplow the hydraulic system should be filled with No. 10W motor oil for easy operation in low temperatures.

Although there are various types of hydraulic dump trailers, the type shown in Fig. 5 has a hydraulic system which is especially adapted to a small two-wheel trailer chassis. The drawings are intended merely as suggestions for constructing a trailer adapted to the needs of the individual, hence complete construction details are not given. As shown the trailer body is fitted with side-mounted lift cylinders and a pivoted dumping endgate. The body frame, chassis frame and drawbar are welded steel angles and channels, and the bed, sides and ends can be made of steel plates or hardwood boards bolted to the steel frame



of the body to give the depth required.

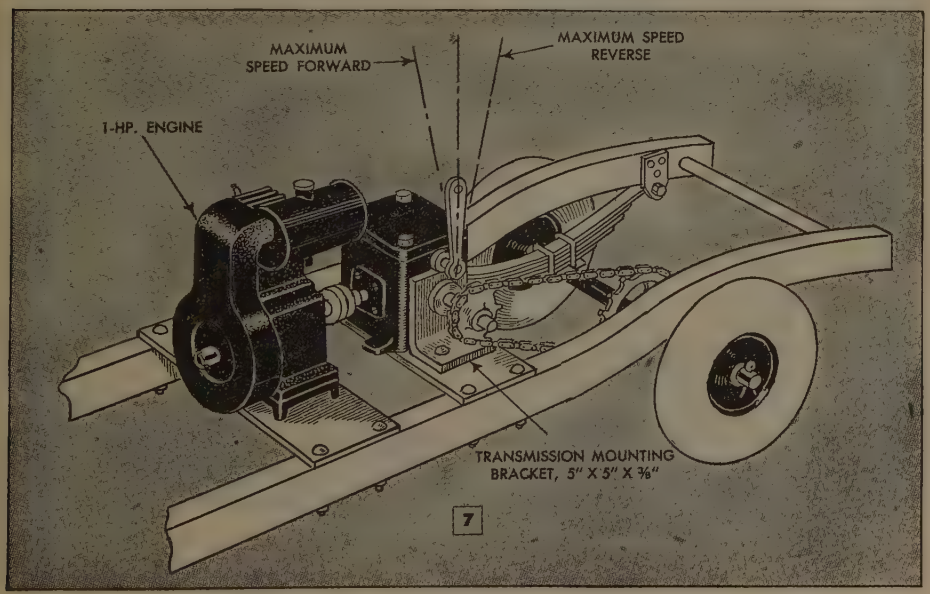
The hand pump is shown mounted on a steel plate on the left side of the chassis frame. This plate is welded to the frame members and serves both as a base for the pump and as a frame-reinforcing gusset. The hydraulic cylinders are bolted to A-frames at the top, and the piston eyes, or clevises, pivot in special brackets welded to the chassis frame. Two cylinders are required, one on each side of the bed, and they should be of sufficient length to lift the pivoted bed to the required height for dumping loose material.

Nearly all late-model farm tractors come equipped with hydraulic pumps and accessory hydraulic fittings are supplied for various purposes. However, it occasionally is advantageous to build a hydraulic unit for special jobs, or for use on an older tractor not equipped with a hydraulic pump. A typical hydraulic-lift unit for operation of a tractor scoop is shown in Fig. 6. This unit features hydraulic-lift and scoop-control cylinders and dual control valves. The usefulness of this assembly is not confined to the operation of a farm-tractor scoop. It is suitable for other purposes as well, as all cylinders permit force to be applied in two directions.

In any hydraulic-lift installation where movement of the parts requires provision for flexibility in the pressure lines, always use a synthetic-rubber braided line especially designed for hydraulic systems. Avoid the use of rigid pipe wherever possible. In some cases it is necessary to install T-fittings with one opening plugged to provide a means of bleeding air from the system. Usually these fittings should be installed at the top ends of the cylinders.

Many builders of midget cars utilize hydraulic transmissions. These are available in several types and sizes. Most of the units are self-contained and will handle readily the power output of 1 to 5-hp. engines. The units also are available with input and output speeds in varying ratios. For example, one unit is available in which the maximum speed of the output shaft is only about ⅓ the speed of the input shaft. Another delivers the same speed at the output shaft as that of the input shaft when the control

Builders of midget cars of nonprofessional types often utilize flexibility of self-contained hydraulic transmission which is available in several types and sizes with input and output-shaft speeds in varying ratios

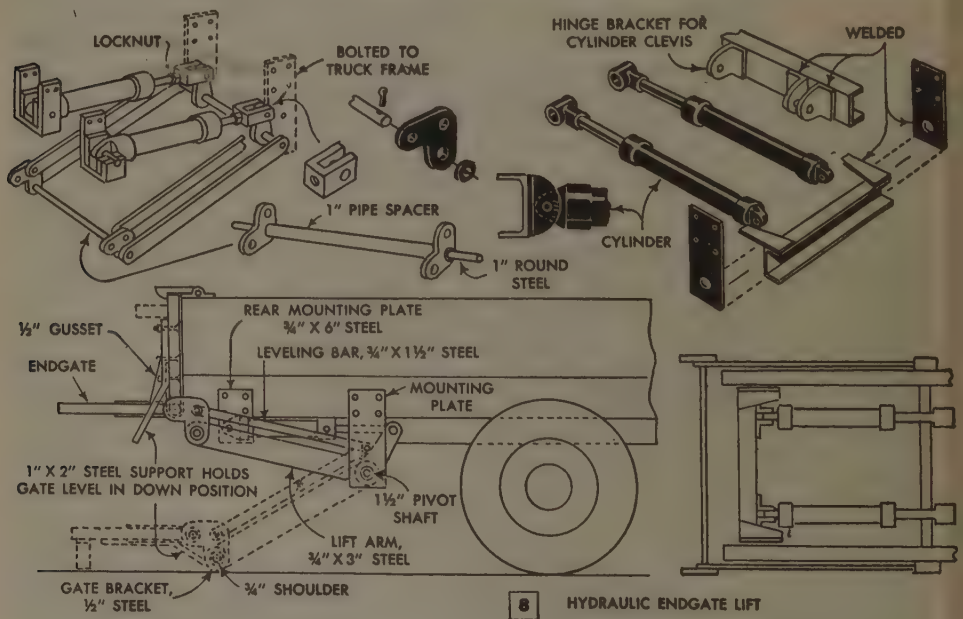


lever is set to the maximum forward speed. In nearly all units the speed can be varied from zero to maximum simply by moving the control lever forward or back. On several of these units no clutch is necessary. Fig. 7 shows a typical installation. Although this unit is shown in direct drive with the engine connected to the transmission through a flexible coupling, some types of hydraulic transmission will require a belt reduction from the engine to the input shaft in order to take full advantage of the speed range. Speed reductions to the rear axle of the car are accomplished by means of roller-chain or V-belt drives.

Another hydraulically operated labor saver for farmers and truckers is the automatic truck-gate lift shown in Fig. 8. It can be installed with only minor variations on trucks of nearly all makes having pickup bodies. The hydraulic system required is similar to that used on the tractor-scoop lift, Fig. 6, except that only one control valve is required. Of course, a hand-pump lift could be used, but the slow lifting speed would reduce its efficiency and usefulness in this application.

On trucks fitted with power take-offs, installation of the hydraulic pump is quite simple as the pump usually can be bolted to a bracket attached to the transmission or the truck frame. For intermittent use, the pump can be powered with a starter motor. The battery drain is nominal as the pump is operated only during the lifting stroke of the hydraulic cylinders which normally requires but a few seconds. Only the general assembly of a typical lift is shown in Fig. 8 and the dimensions of the parts are not given as these must be worked out to suit the truck on which the unit is mounted. In most cases the original endgate can be adapted as a combination lift platform and gate. It may be necessary to reinforce it by welding in vertical stiffeners. Light steel channels will serve this purpose. ★ ★ ★

Another hydraulically operated labor saver for farmers and truckers is the automatic truck-gate lift which will lift heavy crates, boxes and barrels from the ground to the truck-bed level in a few seconds' time

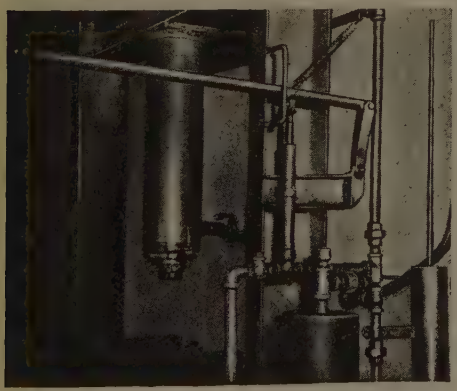


HYDRAULIC PRESS

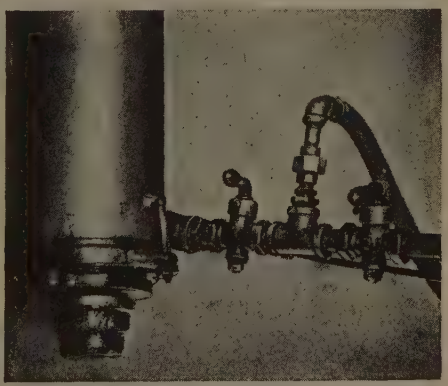
SHOP-BUILT and shop-proved for heavy duty, this fast-acting press has several unusual features that adapt it to a wide range of work, requiring plunger pressures up to 15 tons. That makes installation of press-fit bushings, bearings, and keys a simple job, and you also can handle just about any kind of arbor work that can be set up under the plunger. The design of the press frame gives you a lot of latitude in the choice of salvage materials and parts for its construction. As you will see from the illustration on the opposite page, the press beam is a 36-in. length of railroad rail, but you can use instead two lengths of 6-in. channel with spacers, or webs, welded between the channels to provide the necessary rigidity. The uprights can be built up by welding two heavy steel angles together to form channels. Changes in height and width dimensions also can be made to suit special requirements. The principal feature of the press is the pneumatic plunger return which speeds up duplicate operations as much as 50 percent. When it is desired to raise the plunger quickly after a work stroke has been completed, air under pressure is admitted to the hydraulic cylinder below the piston by means of a manually operated valve. This raises the plunger automatically and forces the hydraulic fluid back into the reservoir. As the piston comes down on the next stroke, residual air below the piston is bled off through an expansion tank. The sequence of operation is quite simple to carry out, even with one hand. To bring the plunger down on the power stroke, the valve at the right in the right-hand photo below, is opened, admitting air under pressure to the hydraulic-fluid reservoir. This forces fluid from the reservoir into the hydraulic cylinder. If necessary, additional pressure on the plunger is built up by a few strokes of the hand pump. Then, to return the plunger, the right-hand valve is closed and the left-hand valve opened to admit air under pressure below the piston. The valves used are of a special type known as key stops, having a reversible check and drain tapping. However, ordinary stop valves having a drain tapping can be used. Note in the general-assembly illustration on the opposite page that the air-bleeder line leading to the air chamber, or expansion tank, is soldered into the drain tapping in the body of the valve. The drain tapping in the body of the right-hand valve is closed with a plug.

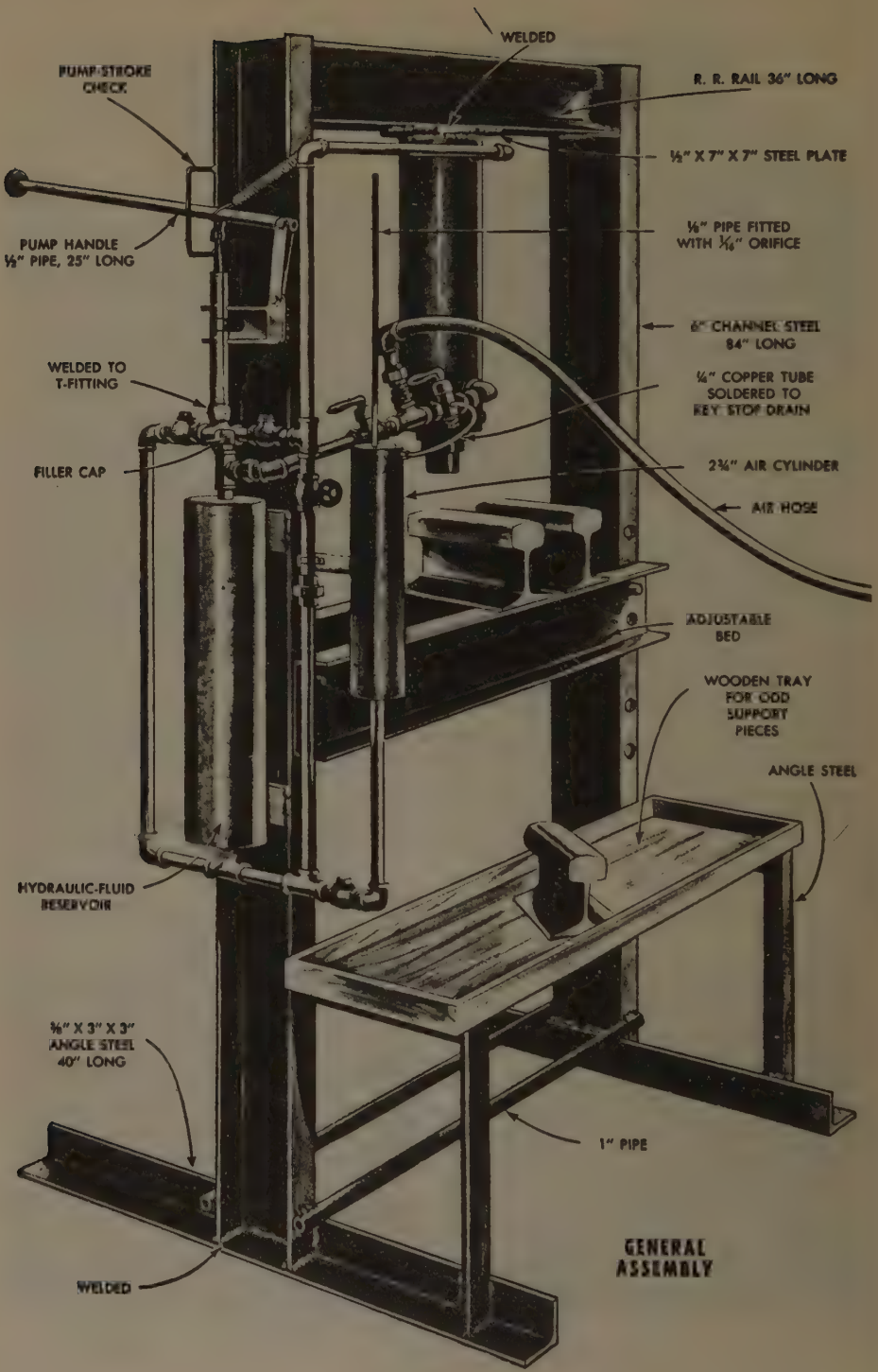
In making the pipe connections to the hydraulic reservoir and pump, it is important that the check valves be properly located. Note especially the position of the check valves in relation to the pump in the assembly view , and be sure that you have them installed so that they permit fluid to flow under pressure to the hydraulic-press

A hand-operated hydraulic pump gives the operator delicate control of pressure applied to the work



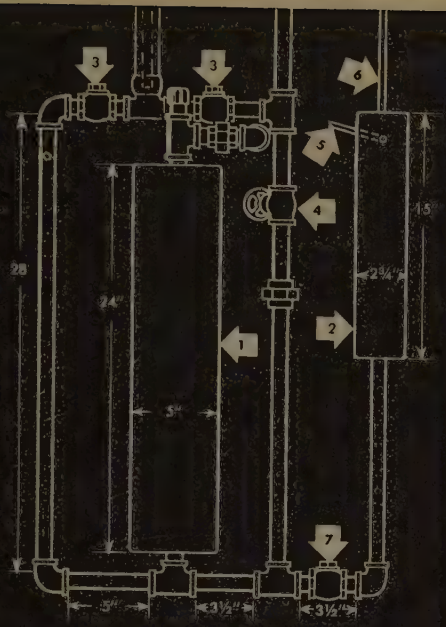
Valves control air pressure to hydraulic cylinder and reservoir. Press can be operated with one hand

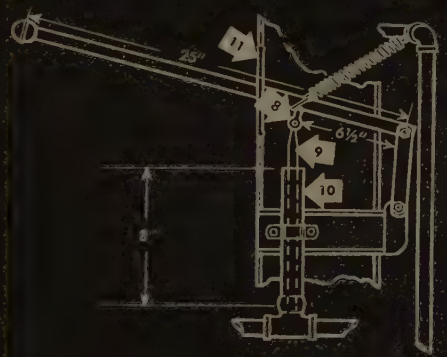



WELDED
PUMP STROKE CHECK
R. R. RAIL 36" LONG
½" X 7" X 7" STEEL PLATE
PUMP HANDLE ½" PIPE, 25" LONG
⅛" PIPE FITTED WITH 1/16" ORIFICE
6" CHANNEL STEEL 84" LONG
WELDED TO T-FITTING
¼" COPPER TUBE SOLDERED TO KEY STOP DRAIN
FILLER CAP
2¾" AIR CYLINDER
AIR HOSE
ADJUSTABLE BED
WOODEN TRAY FOR ODD SUPPORT PIECES
ANGLE STEEL
HYDRAULIC-FLUID RESERVOIR
⅜" X 3" X 3" ANGLE STEEL 40" LONG
1" PIPE
WELDED
GENERAL ASSEMBLY

TANK AND PIPE DETAILS

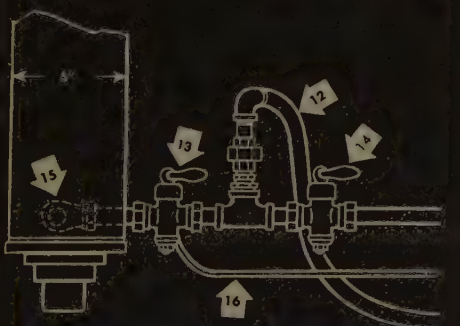
1. Reservoir tank for hydraulic fluid. A short nipple is welded to the openings at each end
2. Small-diameter air-expansion tank. Air and residue fluid enter tank through bleeder tube
3. Check valves, left and right, admit fluid on the pump upstroke, release it on the downstroke
4. Hand valve is closed to prevent the passage of fluid which is being pumped into cylinder
5. Copper tube, soldered to drain opening of key stop, bleeds off air used to raise the piston
6. Small-diameter pipe, fitted with orifice, is welded to opening at the top of the air tank
7. Check valve prevents passage of fluid into air tank, permits fluid residue to pass into line





PUMP DETAILS

8. An auto brake-rod yoke is welded to the pump handle to straddle and hinge to pump plunger
9. The pump plunger is ½-in. round steel, 10 in. long, drilled and tapered to hinge in the yoke
10. A 1 x 8-in. steel rod is bored to receive the plunger and welded to a T-fitting in the line
11. A ¼-in. U-shaped steel rod, welded to straddle the pump handle, serves to check pump stroke



AIR UNIT DETAILS

12. Airline supplies pressure to lift the extended piston and to force fluid from the reservoir
13. Key stop on left admits air pressure to press cylinder, speeds raising the extended piston
14. Key stop on right, with drain plugged, admits air to reservoir, forcing fluid into cylinder
15. Airline is welded to opening in press cylinder, admitting air which raises the extended piston
16. Copper bleeder tube is soldered to key-stop drain opening and leads to fitting in air tank

cylinder above the raised piston. As an example, when the hand-pump plunger is raised, vacuum opens the check valve at the left (see the detail on the opposite page) to allow fluid to enter the pump cylinder. The down stroke of the pump plunger opens the valve at the right and closes the one at the left, forcing fluid to the hydraulic-press cylinder. This manner of utilizing the pump gives the operator a very delicate control of the amount of pressure applied by the plunger.

The hydraulic pump is a simple unit consisting of a handle pivoted in the manner shown and fitted with a return spring, the cylinder being welded to a pipe tee at its lower end. The pump cylinder is made from a 1 x 8-in. length of steel shafting center-bored longitudinally to a diameter of ½ in. The pump plunger is a length of ½-in. steel shafting, 10 in. long, flattened and drilled transversely at the upper end to form an eye for attachment of the handle yoke. The plunger should be lapped into the hole in the cylinder to assure a tight, leakproof fit. The keyed detail drawings on the opposite page give you the general dimensions of the other parts of the hydraulic assembly. The hydraulic-press cylinder is of the type used on dump trucks. Note in the assembly illustration on a preceding page that the upper end of the cylinder—the lower end becomes the upper end when the cylinder is inverted—is welded to a ½ x 7 x 7-in. steel plate which in turn is welded to the press beam as indicated. Note also that the platen beams, which support a plate or fixtures on which the work is placed, are adjustable vertically. Make sure that the rows of holes drilled in the legs of the channels are located so that the beams will be exactly at right angles to the press cylinder when all parts are assembled in working position. A wooden tray at the back of the press frame holds the various fixtures and blocks when not in use.

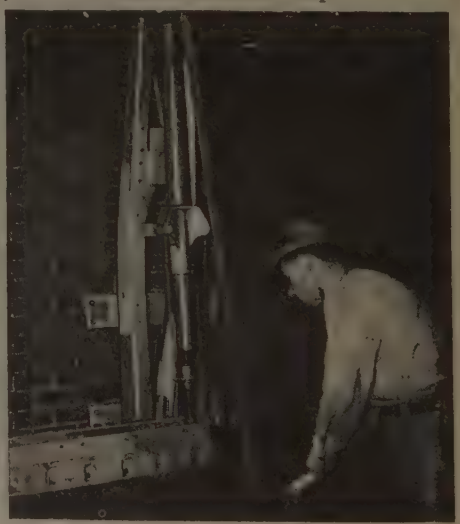
Cylinder From Truck Jack Operates Hydraulic Press

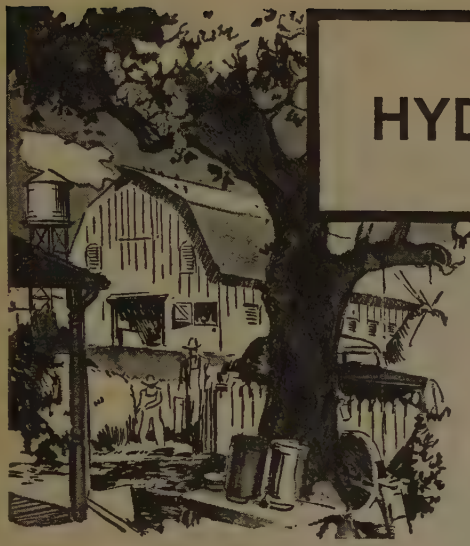
Having only occasional use for a press in his garage, one auto mechanic made this press in which the ram can be moved horizontally to any position within the width of the press frame. The latter was assembled from lengths of 6-in. channel steel, the

two top cross members being placed parallel and with the channels facing to produce a slot in which the ram slides. A 12-ton hydraulic jack, used as the ram, is welded to a square of steel plate. This is bolted in the center to a second steel plate, which overlaps the lower sides of the steel channels. This plate assembly keeps the jack suspended vertically, yet allows it to be moved from side to side. The supply of hydraulic fluid is stored in a tank connected permanently to the jack inlet by a length of copper tubing. The tank is supported on an arm welded to the jack unit.

Easily Installed Airplane Jack Makes Useful Hydraulic Press

An airplane jack, mounted on the wall as shown, makes an effective hydraulic press in this mechanic's shop. This particular jack is used primarily for installing new valve seats in overhead-valve cylinder heads. However, such a jack can be readily adapted for use on various other pressing jobs often called for in the shop.

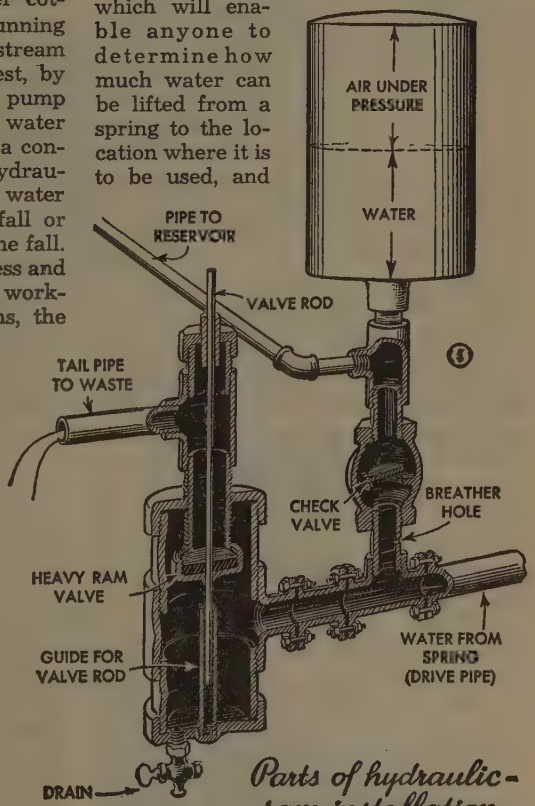




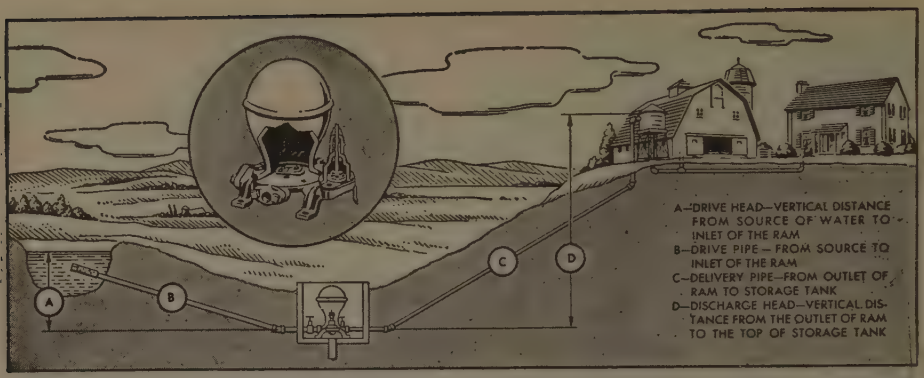
HYDRAULIC RAM

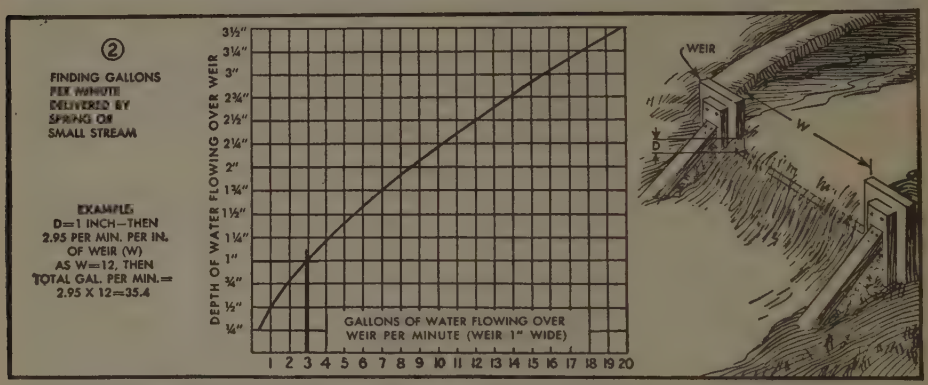
MANY rural homes and summer cottages can be furnished with running water from a near-by spring or stream even though its daily flow is modest, by installing a hydraulic ram. This is a pump which takes advantage of a small water fall to lift a portion of the water to a considerable height. Theoretically, a hydraulic ram should lift one half of the water available twice the height of the fall or 1/20 of it twenty times the height of the fall. But the actual efficiency of rams is less and varies considerably. Fig. 1 shows the working parts. Under normal conditions, the ram valve is open, thus allowing water to flow through the ram. As water flows, its velocity increases until the valve is lifted and quickly closed. Since water in motion possesses energy, a considerable pressure is developed. This pressure opens the check valve, thus admitting a quantity of water to the pressure chamber. When enough water has entered to relieve the excess pressure, the check valve automatically closes, thus preventing water from flowing back. At this instant a small volume of air enters through the breather hole to replenish the air dissolved and carried away by the water. Upon the next stroke of the ram this air will be forced into the pressure chamber. The addition of water to the pressure chamber compresses the air which in turn forces water through the delivery pipe to the reservoir. When the check valve closes, the weight of the ram valve overcomes the pressure against it and drops, thus allowing water to again flow through the tail or discharge pipe, and so the cycle is repeated. Where the water is to be used for drinking, it is best to obtain it from a spring, but if it is to be used for washing, stock watering and other purposes, the supply can be obtained from a small stream.

We shall first explain simplified methods which will enable anyone to determine how much water can be lifted from a spring to the location where it is to be used, and



Parts of hydraulic-ram installation

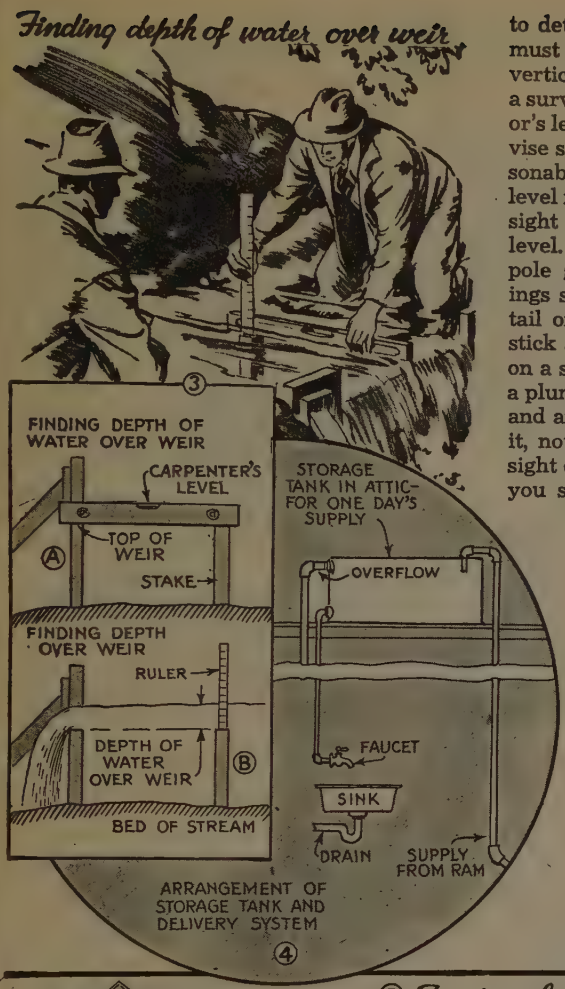

A—DRIVE HEAD—VERTICAL DISTANCE FROM SOURCE OF WATER TO INLET OF THE RAM
B—DRIVE PIPE—FROM SOURCE TO INLET OF THE RAM
C—DELIVERY PIPE—FROM OUTLET OF RAM TO STORAGE TANK
D—DISCHARGE HEAD—VERTICAL DISTANCE FROM THE OUTLET OF RAM TO THE TOP OF STORAGE TANK
A
B
C
D


②
FINDING GALLONS PER MINUTE DELIVERED BY SPRING OR SMALL STREAM
EXAMPLE:
D=1 INCH—THEN 2.95 PER MIN. PER IN. OF WEIR (W)
AS W=12, THEN TOTAL GAL. PER MIN.= 2.95 X 12=35.4
DEPTH OF WATER FLOWING OVER WEIR
3½" 3¼" 3" 2¾" 2½" 2¼" 2" 1¾" 1½" 1¼" 1" ¾" ½" ¼"
GALLONS OF WATER FLOWING OVER WEIR PER MINUTE (WEIR 1" WIDE)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
WEIR
H
D
W

First measure distance D, which is the depth of water flowing over the weir, by the method shown in Fig. 3. Locate this value at the left-hand side of the chart, follow across to the curve, and then drop down where the amount of water in gallons per minute for each inch of weir length is given. Multiplying this number by the length of the weir in inches gives the total amount of water passing over the weir per minute

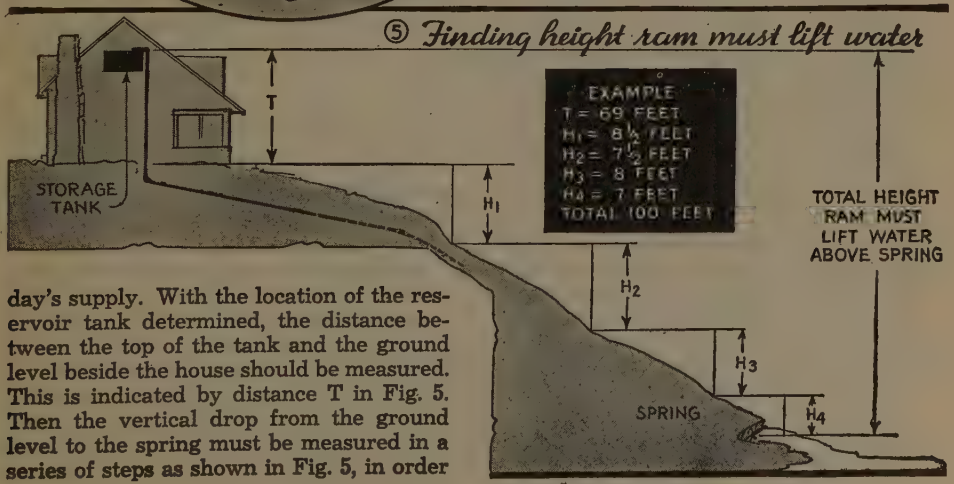
then illustrate methods of surveying the spring and determining the other necessary values. Then the spring must be surveyed first to find whether it will deliver enough water. To do this it is dammed as shown in Fig. 2, so that all of the water flows over the edge of the board or "weir." The weir must be perfectly level and so arranged that no water can flow under or around it. The flow should be slow and free from turbulence. The depth of the water flowing over it is measured as shown in Fig. 3. First drive a stake a couple of feet above the weir, the top of both stake and weir being level, which can be determined by the method shown in detail A. Then the distance from the top of the stake to the surface of the water is measured as in detail B. We can now determine the amount of water in number of gals. per min., by referring to Fig. 2. To illustrate the method we will assume that the depth of water flowing over the weir is one inch. We locate one inch on the left-hand side, following across to where this line meets the curve, and drop down to read a trifle below 3, say 2.95, as the gals. per min. for each inch of weir. Next we multiply this by the length of the weir which we will assume to be 25 in., giving a total of 73.75 gals. per minute. As the flow of springs varies with the seasons, it is necessary to estimate the minimum flow if this is not known. Let us assume that the flow during the dry season is 10 gals. per min. This value can, of course, be determined during the dry season by the weir method as explained.

Next, it is necessary to determine how high the ram will have to pump water to fill the supply reservoir, which may be located in the attic or other convenient place. Some use an outside tank. Fig. 4 shows a practical arrangement for the water-supply system. The reservoir or supply tank should be large enough to hold an entire

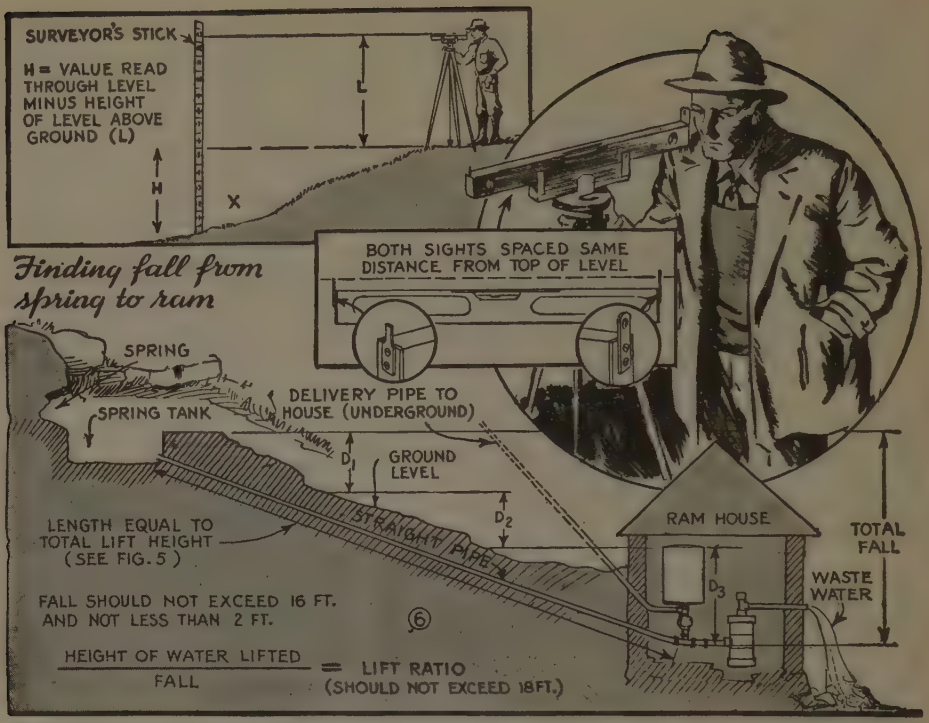


to determine the height that the water must be raised. The measurements of vertical drop are made with the use of a surveyor's level and stick. If a surveyor's level is not available you can improvise something that will work with reasonable accuracy from a carpenter's level fitted with sights so that the line of sight will be parallel to the top of the level. For the stick you can use a long pole graduated with numbered markings spaced 6 in. apart. The upper detail of Fig. 6 illustrates how level and stick are used, the level being mounted on a suitable tripod which is fitted with a plumb bob. Set the stick at location X and after adjusting the level, sight over it, noting the height where the line of sight crosses the stick. From this height you subtract L, which is the distance from the level to the ground, and the remainder is distance H. Then set the level with the plumb bob at point X and repeat the process. In this way distances H_1, H_2, H_3 and H_4 of Fig. 5 are measured. Adding all of these to distance T gives the height that water must be lifted from the spring to the top of the tank. It is not necessary that the path taken between the house and the spring be straight.

It must then be determined how great a fall of water is available for operating the ram. To do this, locate a point below

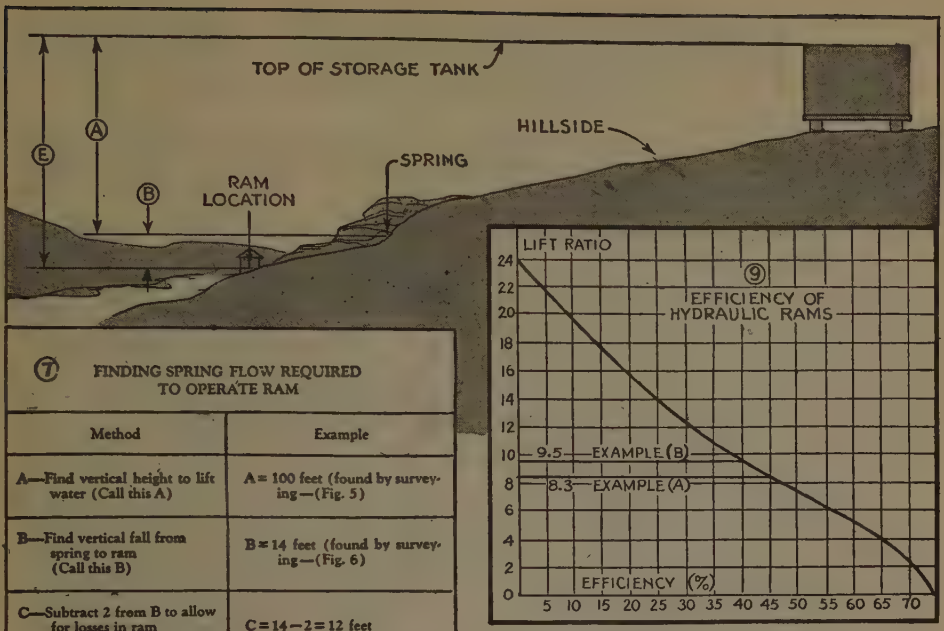


day's supply. With the location of the reservoir tank determined, the distance between the top of the tank and the ground level beside the house should be measured. This is indicated by distance T in Fig. 5. Then the vertical drop from the ground level to the spring must be measured in a series of steps as shown in Fig. 5, in order


SURVEYOR'S STICK
H = VALUE READ THROUGH LEVEL MINUS HEIGHT OF LEVEL ABOVE GROUND (L)
L
H
X
BOTH SIGHTS SPACED SAME DISTANCE FROM TOP OF LEVEL
Finding fall from spring to ram
SPRING
SPRING TANK
DELIVERY PIPE TO HOUSE (UNDERGROUND)
GROUND LEVEL
D1
D2
D3
LENGTH EQUAL TO TOTAL LIFT HEIGHT (SEE FIG. 5)
STRAIGHT PIPE
RAM HOUSE
TOTAL FALL
WASTE WATER
FALL SHOULD NOT EXCEED 16 FT. AND NOT LESS THAN 2 FT.
⑥
HEIGHT OF WATER LIFTED / FALL = LIFT RATIO (SHOULD NOT EXCEED 18FT.)

Besides measuring the vertical drop from the top of the reservoir tank to the spring, the additional drop from the spring to the ram, located not over 16 ft. below the spring, should be measured in the same way, using the level system shown in the upper details

the level of the spring from which the waste water from the ram can easily drain away. The straight pipe-line distance between the spring and the ram should be about the same as the vertical height to which the ram must lift the water. To continue with the example, we will assume that the top of the supply tank was found to be 100 ft. from the spring. This means that a pipe at least 100 ft. long will have to be run from the spring, straight but sloping downward, to a place below the spring where the ram will be located. Having determined the ram location, which should not be less than 2 ft. nor more than about 16 ft. below spring level and 100 ft. or more from the spring as shown in Fig. 6, we are ready to find the fall or head available for pumping water. This is the vertical height of the spring above the ram location and is found with a surveyor's level and stick as previously explained. We will assume our survey shows that the total fall (Fig. 6) is 14 ft. Then from Fig. 7 it is easy to determine whether a spring will pump as much water as is required. Assuming that the ram will be located 14 ft. vertically below the spring, Fig. 6, we deduct 2 ft. to allow for frictional loss in the drive pipe. This leaves 12 ft. as the fall available for pumping water. We will also assume that the requirements are 550 gals. of water per day. Referring to Fig. 6, we add the lift to the fall and multiply this by the number of gals. per day, that is, 550 multiplied by 114 or 62,700. Next, according to G of Fig. 7, the fall available for operating the ram, which is 12 ft., is multiplied by 14.4 which equals 172.8. We must next determine the efficiency of the ram by referring to Fig. 9. To do this we divide the height the water is to be lifted above the ram, or 114 ft., by the fall from the spring to the ram, or 14 ft., to get the lift ratio. In this case 114 divided by 14 equals 8. We locate this at the left side of Fig. 9, example A, follow across to the curve and down to the bottom and read 45 percent as the efficiency. Multiplying this by 172.8, as shown in Fig. 7, we get



To find the efficiency of a ram, you first determine the lift ratio by dividing the height that water is to be lifted above the ram, by the fall from the spring to the ram

⑦ FINDING SPRING FLOW REQUIRED TO OPERATE RAM

Method	Example
A—Find vertical height to lift water (Call this A)	A = 100 feet (found by surveying—(Fig. 5)
B—Find vertical fall from spring to ram (Call this B)	B = 14 feet (found by surveying—(Fig. 6)
C—Subtract 2 from B to allow for losses in ram (Call the answer C)	C = 14 − 2 = 12 feet
D—Estimate gallons of water per day required (Call this D)	D = 550 gallons per day (estimated)
E—Add A and B to find total lift (Call this sum E)	E = 100 + 14 = 114 feet
F—Multiply D by E (Call this product F)	F = 550 X 114 = 62,700 foot gallons per day
G—Multiply C by 14.4 and this product by efficiency of ram (Fig. 9) (Call this G)	Since efficiency = 45% (Fig. 9) G = 14.4 X 12 X 45 = 7776
H—Divide F by G to find gallons per minute required of spring	H = 62,700 ÷ 7776 = 8 gallons per minute required from spring

⑧ FINDING GALLONS OF WATER PER DAY AVAILABLE FROM SPRING

Method	Example
I—Multiply 14.4 by gallons per minute from spring (Call this product I)	Spring delivers 10 gallons per minute and the fall is 14 feet. Water must be lifted 100 feet above spring. I = 14.4 X 10 = 144
J—Multiply I by C (See Fig. 7) and by the efficiency (See Fig. 9 for C) (Call this product J)	Since C = 14 − 2 = 12 and efficiency 45% J = 144 X 12 X 45 = 77,760
K—Divide J by E to get gallons pumped per day (See Fig. 7 for E)	K = 77,760 ÷ 114 = 682 gallons per day

7776 as the answer. The next step is to divide the first product, or F, by the second product G, or 62,700 divided by 7776, which equals 8 gals. per min. as the amount of water which the spring will have to supply in order to furnish the required amount of water.

If the spring supplies 12 gals. of water per min. during the dry season, we will be safe in installing the ram. But if, after making these determinations, it should be found that the spring will not deliver sufficient water, the next thing to do would be to figure how much water could be pumped per day during the dry season. Fig. 8 illustrates the method of making this calculation. Then, after you have found that there is sufficient fall available to operate a ram, the job of figuring the exact size required, and how to install it, comes next. This is thoroughly covered in the following pages, which also contain workable methods of making parts cheaply from pipe fittings. Hydraulic rams are made in a number of sizes and varieties; their advantage over home-made rams is that they have been developed for long use and minimum trouble.

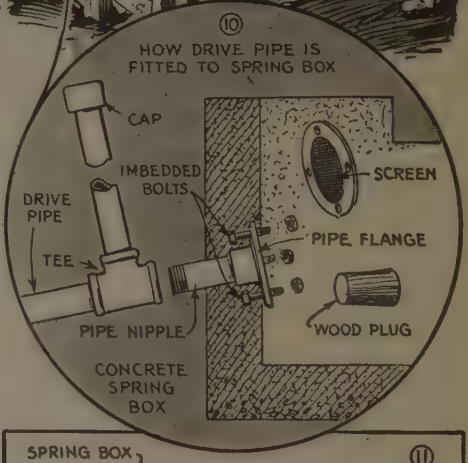
HYDRAULIC RAM

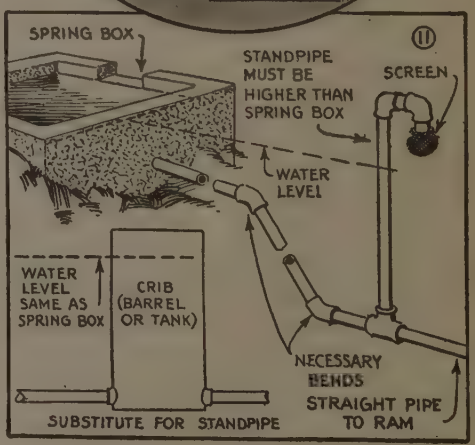
is made from pipe fittings

Design, Construction and Installation of Rams

AFTER surveying the spring or stream we will now proceed with the design and construction of a ram. The initial step is to find the size of the drive pipe, that is, the pipe which runs from the spring to the ram. The chart shown in Fig. 12 makes this easy. First refer to the bottom of the chart and locate the number corresponding to the gallons of water per minute which must be furnished to the ram. Continuing with the example that was followed in Part I, which required 8 gals. per minute, we locate 8 gals. per minute at the bottom of the chart, draw a vertical line to the curve, and at the point where this line crosses the curve, draw a horizontal line to the left-hand side of the chart and find that a ram-pipe size between 1¼ and 1½ in. will be required. Accordingly, we will select the nearest larger standard pipe size, or a 1½-in. pipe. The delivery pipe that runs from the ram to the supply tank should be one half this diameter, or in this case, ¾ in. In all cases where the size of pipe required comes out a fraction under standard size of pipe, then the next larger standard size should be used. In no case should the smaller size be used as this would tend to reduce the rate of flow to an extent which would probably interfere with the satisfactory performance of the installation.

Fig. 10 shows a method of attaching the drive pipe to the crib or spring box. The spring box, preferably of concrete, should be constructed so that all of the water, or a sufficient amount of it, flows into the box. The side from which the excess water is to be allowed to overflow should be made a few inches lower than the rest of the box so that the surplus will flow in the proper direction. The pipe from the ram should enter the side of the box as shown. By this means all of the water issuing from the spring can be used for operating the ram during dry seasons. If the tem-

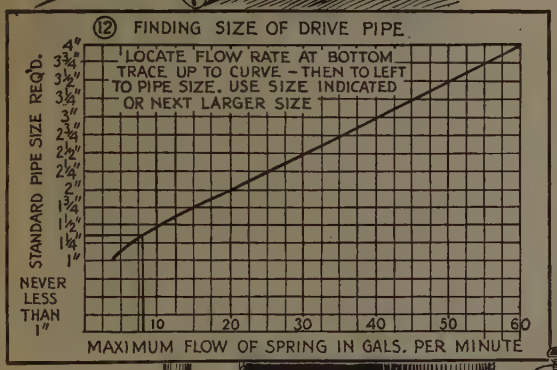


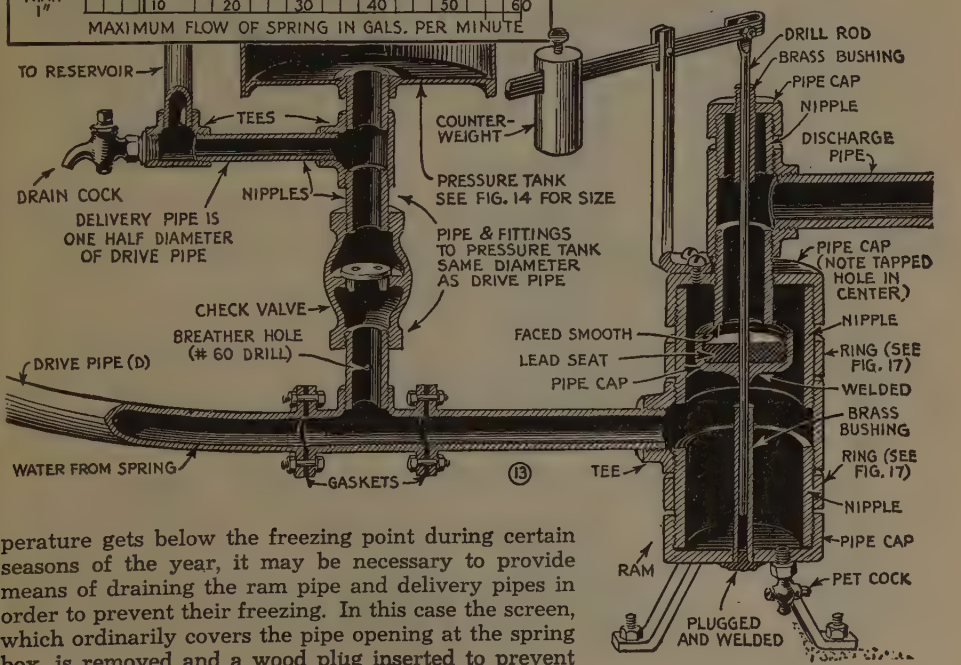


further flow, after which the cap on the vent pipe is unscrewed so that the draining of the pipe is assured. Then drain cocks at the ram and pressure tank are opened to allow all water in the installation to drain off.

The ram pipe should be run straight from spring to ram, if possible. If this is impossible, one of the methods shown in Fig. 11 may be used. The standpipe must be of the same or of larger diameter than the drive pipe and must extend vertically to a height a few inches above the level of the water in the spring tank. This pipe has a "goose neck" at the top to prevent the entry of dirt. A screen should also be placed over the open end to prevent insects from entering. Similar cautions are required in the use of the crib which may be used as a substitute for the standpipe.

Having determined the pipe sizes and laid out the ram line, we are ready to construct the ram. Fig. 13 shows details for the assembly of an effective type of ram which can be made from ordinary pipe fittings. Note that all of the dimensions are figured from the diameter and length of





perature gets below the freezing point during certain seasons of the year, it may be necessary to provide means of draining the ram pipe and delivery pipes in order to prevent their freezing. In this case the screen, which ordinarily covers the pipe opening at the spring box, is removed and a wood plug inserted to prevent

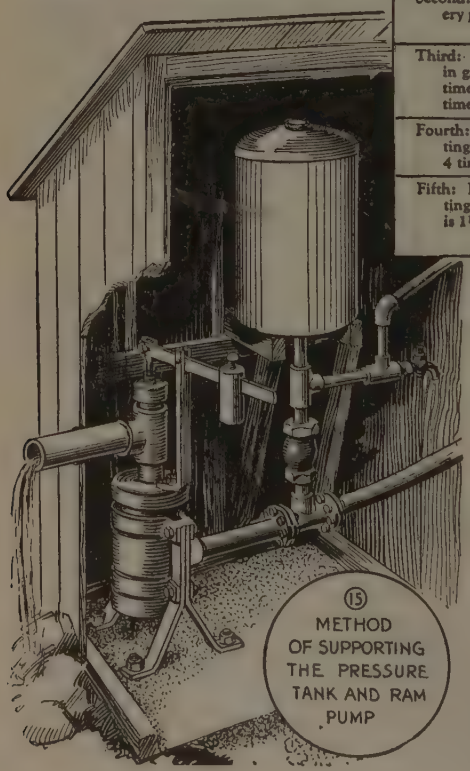
the ram pipe as shown in Fig. 14. The pressure tank should have a capacity in gallons approximately equal to the volume of the drive pipe. Applying the simplified formula given in Fig. 14 to our example, we first multiply the diameter of the drive pipe by itself. Thus for a 1½-in. drive pipe, we get 2.25. Next we multiply this by the length of the drive pipe in feet, assumed to be 100 ft. and then by 0.041 to find the size of the pressure tank in gallons. Performing this operation, we get 2.25 times 100 times 0.041 equals 9.2 gallons. A 10-gal. expansion tank of the kind used on hot-water heating systems will be satisfactory. The tank selected should not be smaller than 9.2 gals. and not much over 15 percent larger.

The ram proper is made from sections of pipe and fittings whose diameters are four times the diameter of the drive pipe. Therefore, in our example, we must use 6-in. pipe and fittings for the ram. The ram discharge pipe should be 1½ times the diameter of the drive pipe. All of these values are given in Fig. 14. The ram valve is made by drilling a hole exactly through the center of a pipe cap and pressing a length of drill rod through it as shown. The drill rod should be welded to the pipe cap as shown to prevent it from slipping. Next, the pipe cap is filled with molten lead as indicated. The purpose of the lead is to form a soft bed which can easily seat on the end of the faced pipe nipple which extends from the top of the ram. This rod is guided by the top insert of brass tubing and a similar length of brass tubing in the bottom cap of the ram. The drill-rod end which projects through the top pipe cap should be drilled and coupled to the counterbalance, Fig. 16.

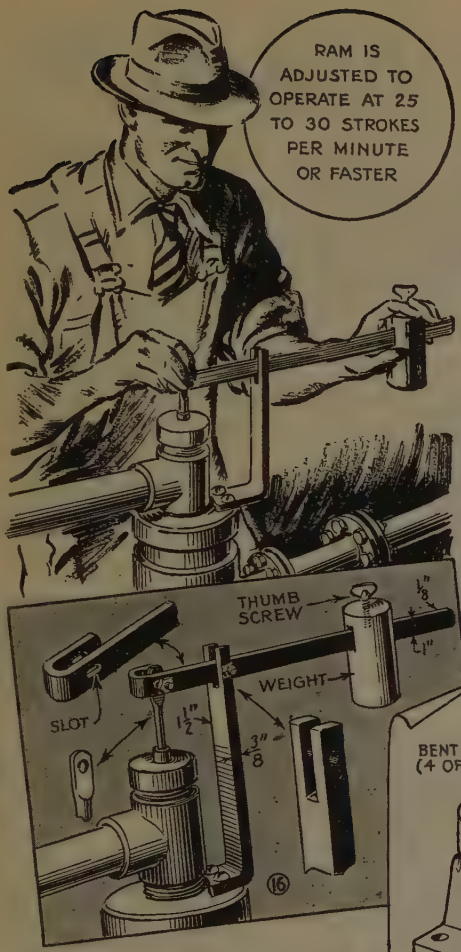
When these parts are properly assembled and the ram installed rigidly, which can be done as shown in Fig. 17, it will be

DESIGN DATA TO DETERMINE SIZE OF PIPE, ETC.
FIG. 14

Procedure	Example
First: Find drive-pipe diameter from Fig. 12. Call this "D"	As 8 gal. per min. is flow from spring, Fig. 12 shows drive pipe should be 1½ in.
Second: Find diameter of delivery pipe. This should be ½ D	½ of 1½ gives ¾ in. for size of delivery pipe. Never use pipe less than ½ in.
Third: Find size of pressure tank in gallons. This is D times D times the length of drive pipe. times .041	1½ times 1½ times 100 (length of drive pipe) times .041 equals 9.2 gal. required size of pressure tank
Fourth: Find size of pipe and fittings for ram. This should be 4 times D	Drive-pipe dia. 1½ in. times 4 gives 6 in. for size of ram pipe and fittings
Fifth: Find size of pipe and fittings for discharge pipe. This is 1½ times D	Drive-pipe dia. 1½ in. times 1½ gives 2¼ in. for size of discharge pipe and fittings.



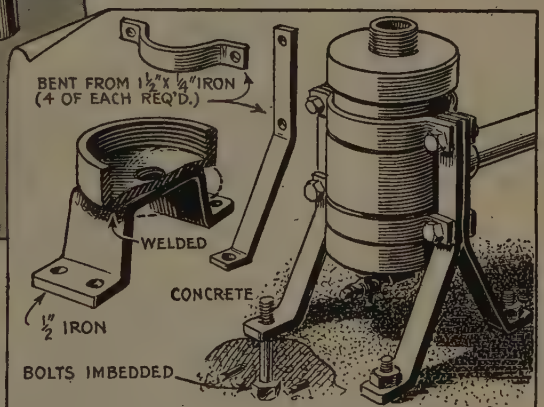
⑮ METHOD OF SUPPORTING THE PRESSURE TANK AND RAM PUMP



found that there is a position at which the counterweight can be located so that merely touching the lever arm will cause the valve to close or open. The exact location of the weight will be found after the ram has been installed.

A length of pipe may be connected to the discharge "tee" in order to guide the tail water away from the ram house. In no case should this pipe be bent or should fittings be used, as bends would slow down the flow of water and interfere with operation. This, and a good method of mounting both the ram and pressure tank, are shown in Fig. 15.

The check valve between the drive pipe and pressure tank, Fig. 13, should be arranged so that water can flow from the ram pipe into the pressure chamber but not in the reverse direction. A substantial type of check valve of good quality should be used. Unused holes in the pressure tank should be closed carefully with pipe plugs. The tank must be tested for leaks carefully. If there is even a small leak, the "hammer" of the ram will burst it. There is one other important point which must be noted in connection with the assembly of the ram and that is the small breather hole below the check valve. This hole should be drilled with a No. 60 drill. It should be located where it can be inspected easily. The purpose of this hole is to allow the entrance of air immediately after the check valve closes. The air that enters during this period collects under the valve and is forced into the pressure chamber during the next stroke of the ram. If this small hole is omitted, the air in the pressure chamber will slowly decrease, as it is absorbed by the water, and thus no air pressure will be available for lifting the water. When the installation is complete it is only necessary to remove the plug from the ram pipe in the spring box or crib, and adjust the counterweight until the ram operates at between 25 and 30 strokes per minute or faster.



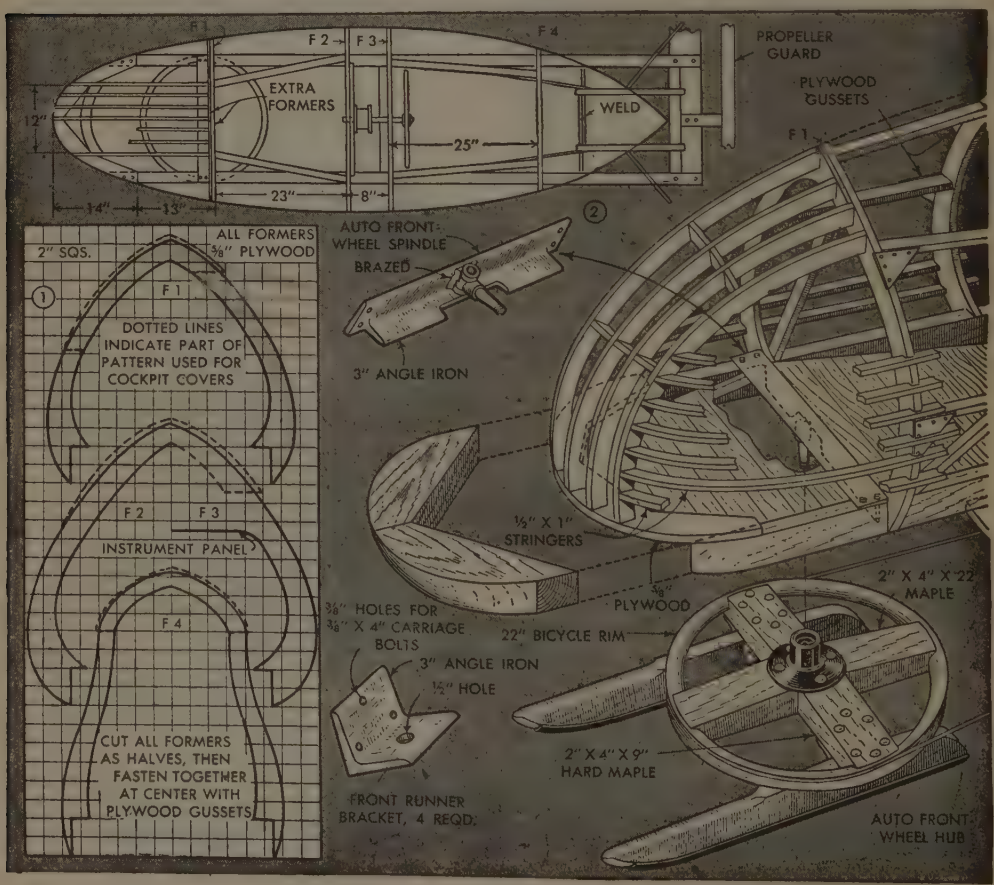
⑰ TWO METHODS OF RIGIDLY FASTENING THE RAM

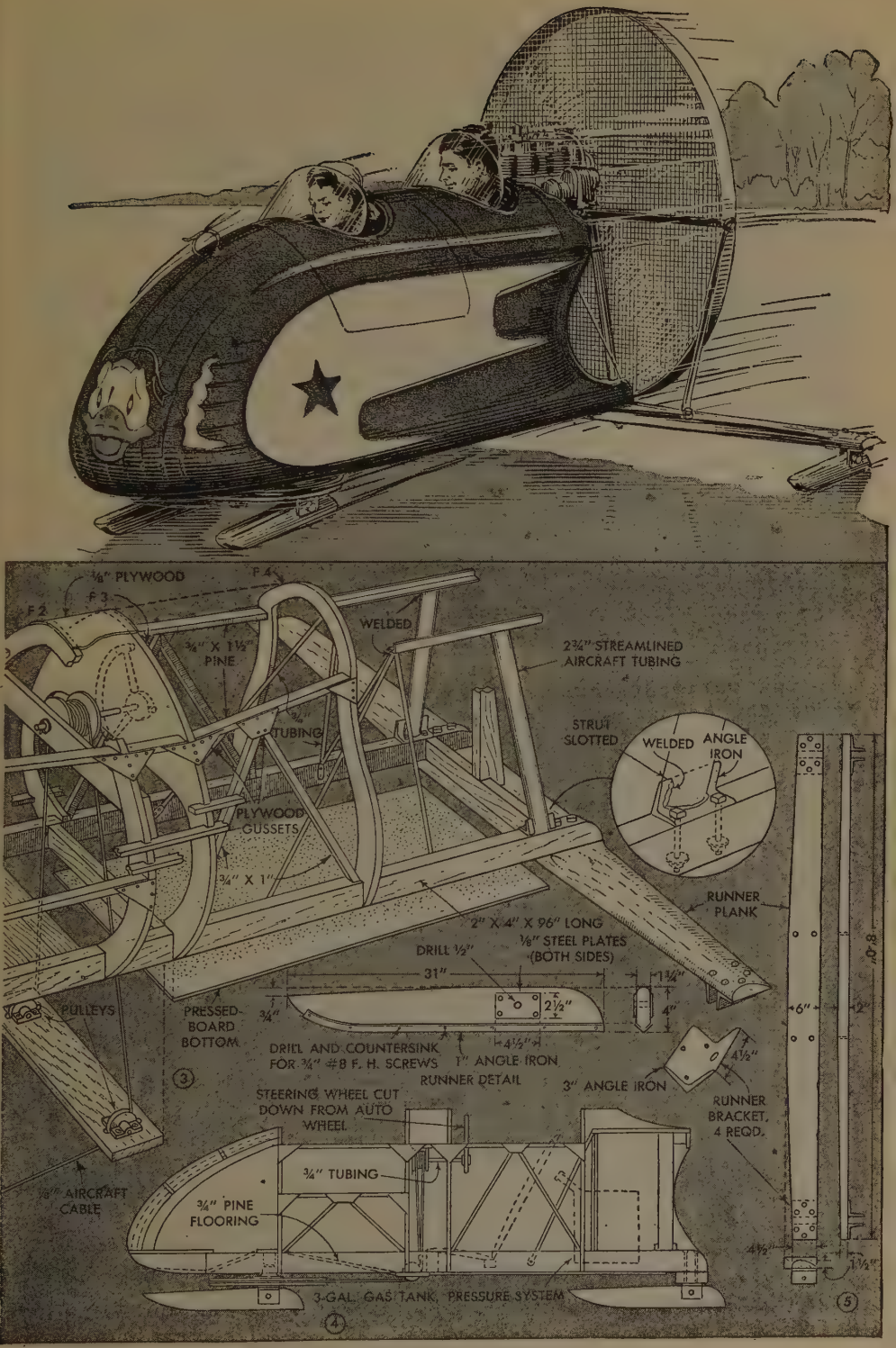
If a homemade ram does not stand up under the constant hammering and requires too frequent replacement of the valve, it might be advisable to improve this part of the installation by substituting a manufactured ram. The instructions contained in these articles apply whether a homemade or manufactured ram is used.

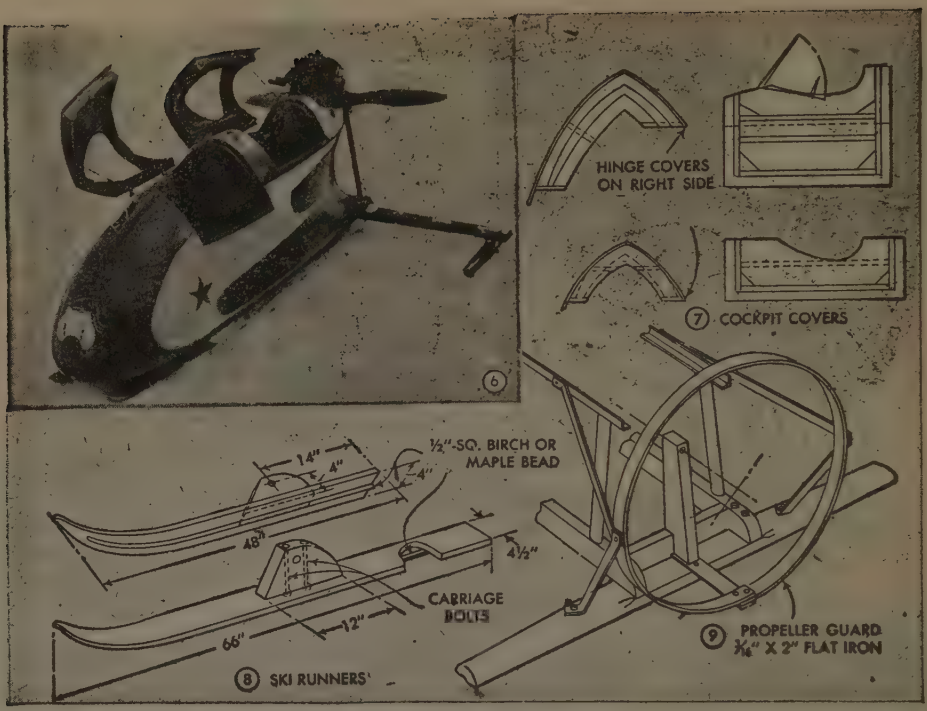
ICEBOAT

SPEEDS approaching 100 miles per hour on ice and a mile a minute on snow are claimed by the builder of this streamlined aero-driven ice boat. The original was powered by a four-cylinder motorcycle engine, although a twin-cylinder one, converted for the purpose, can be used. The engine cradle or mount may vary somewhat in each particular case; otherwise, construction remains the same. The chassis consists of two 8-ft. lengths of 2 by 4-in. stock bolted to a runner plank as detailed in Fig. 5. At the front, the rails are cut to receive a round nose block, which is fastened permanently later. Next, cleats are nailed to the inside of the rails and ¾-in. floor boards nailed to them in the manner shown. The king-pin assembly is improvised by brazing the spindle of an old Chevrolet front wheel to a length of 3-in. angle iron cut according to Fig. 2.

The fuselage formers are shown on squares in Fig. 1 for enlarging to full size, and Fig. 2 gives the position of each one. For economy, each former can be cut out in two parts and later joined at the center with a wood or sheet-metal gusset. If plywood is not available, the formers can be cut from solid stock and joined in the same manner. After the formers are fastened in place, the nose of the fuselage is framed as in Fig. 3. This is made up of seven plywood formers, a center one with three on each side. Fig. 4 gives the profile of the center one; the others are shaped and fitted, as the work progresses, to produce a nicely rounded nose. The upper ends of the formers are screwed to F1, while at the bottom a plywood plate, matching the contour of the nose block, permits fastening the formers with screws




¼" PLYWOOD
F 4
F 2
F 3
WELDED
¾" X 1½" PINE
2¾" STREAMLINED AIRCRAFT TUBING
¾" TUBING
STRUT SLOTTED
WELDED
ANGLE IRON
PLYWOOD GUSSETS
¾" X 1"
RUNNER PLANK
2" X 4" X 96" LONG
⅛" STEEL PLATES (BOTH SIDES)
DRILL ½"
31"
1¾"
2½"
4"
PULLEYS
PRESSED-BOARD BOTTOM
¾"
DRILL AND COUNTERSINK FOR ¾" #8 F. H. SCREWS
4½"
1" ANGLE IRON
RUNNER DETAIL
3
3" ANGLE IRON
4½"
RUNNER BRACKET, 4 REQD.
STEERING WHEEL CUT DOWN FROM AUTO WHEEL
¾" TUBING
¾" PINE FLOORING
AIRCRAFT CABLE
3-GAL. GAS TANK, PRESSURE SYSTEM
4
6"
2"
8"
4½"
1½"
5



from the underside. With this done, the nose block can be fastened permanently.

From the nose you work on back, adding the rails and gussets between each former where indicated in Fig. 3. Note that F2 is fitted with a crosspiece to support the steering-wheel shaft, and that the space between F2 and F3 is covered with thin plywood down to the first crossrail on each side. Next, the stringers are added. These are narrow strips that run lengthwise from the nose to F4 to produce a framework for the cloth covering. The strips are glued in notches ½ in. deep and spaced about 2 in. apart in the edges of the formers. The front ends may have to be steamed or kerfed to produce a sweeping curve. The board carrying the pulleys can be fastened next, also the pressed-board floor panel.

The front-runner assembly consists of an old bicycle rim, which is fastened to half-lapped crossmembers having a Chevrolet front-wheel hub bolted to them exactly in the center. The cable connecting the runners with the steering wheel is threaded through the pulleys and wrapped several times around a 2-in. spool pinned to the steering-wheel shaft. Both front and rear runners are pivoted in chocks cut from 3-in. angle iron. The runners detailed above Fig. 4 are for use on ice, while those shown in Fig. 8 are recommended for snow.

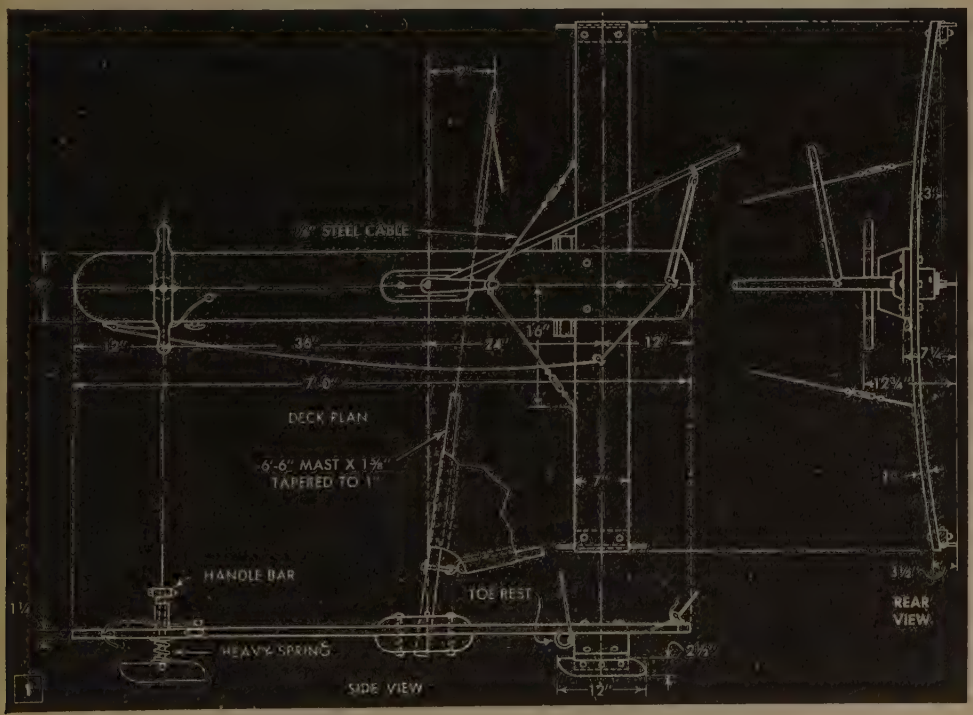
You'll do best to build the cockpit covers right in their openings, tacking the formers to the fuselage formers temporarily and then gluing and nailing 3/32-in. plywood to the edges. When dry, the unit is lifted out and braces and corner blocks are added according to Fig. 7. The shape of the formers for the cockpit covers is given in Fig. 1. Note that they must project ½ in. above the others to be flush with the stringers. In Fig. 6 you can see how the covers are hinged along the right-hand side and how they are fitted with check cords. Heavy celluloid, supported by sheet-metal brackets, provides suitable windshields, and slit sections of rubber hose applied to the rough edge of the head openings pads the edges. As previously mentioned, the engine cradle may require changing somewhat to suit the engine being used, but it should be well braced in the manner shown. This is also true of the propeller guard detailed in Fig. 9. Rigidity of these parts is essential if the boat is to perform satisfactorily. Seats, gas tank and covering remain. Muslin is used for the covering and is drawn firmly over the framework and tacked to the underside of the chassis and to a stern post bolted to the chassis. Then the cloth is coated three or four times with airplane dope to make it taut, after which it is painted.

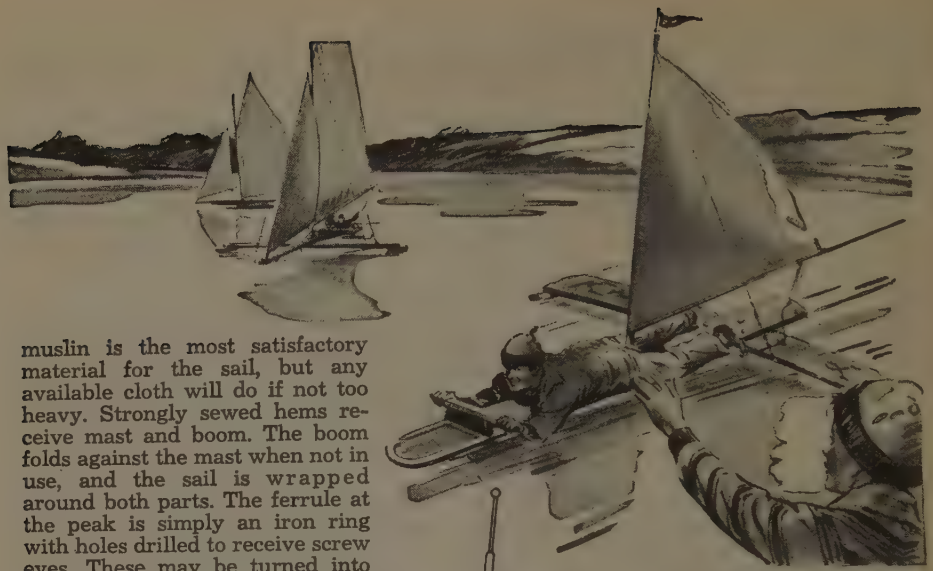
ICEBOAT FOR BOYS

It's made boy-size and it can be boy-built, but there's no reason why you can't make it grown-up size by merely increasing the dimensions

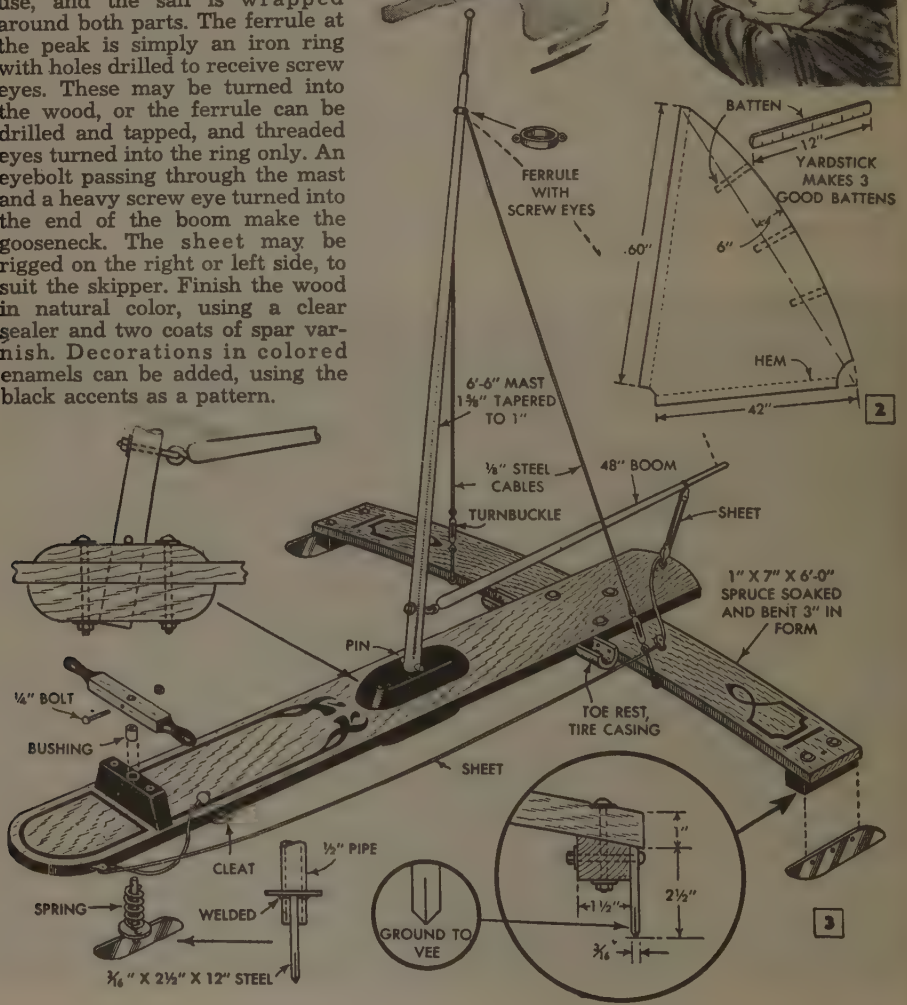
THIS SPEEDY little iceboat has the advantages of unobstructed vision, low center of gravity and spring action to absorb shocks from rough ice. These characteristics make it especially suitable for iceboating on ponds, small lakes and rivers. With the mast unstepped it is compact enough to be carried on top of a car, and light enough to be towed by hand like a sled.

The frame or chassis consists of only two parts, the runner plank and the body plank. The runner plank is bent as shown in Fig. 1, by soaking the piece overnight or steaming it an hour or more and placing in a rough form until it dries and sets. Spruce is the best wood for the runner plank, although selected white pine will do if the former is not available. Figs. 1, 2 and 3 detail the simple construction clearly. Runners, Figs. 1 and 3, are of steel, ground to a V-shape on the running edge. Forward end of the frame is carried on a coil spring mounted as in the lower left-hand detail in Fig. 3. Upper end of the steering shaft turns in a bushing cut from brass tubing. Rear runners are bolted to hardwood blocks which are attached to the ends of the curved runner plank. The mast, you'll note, is tapered above the step and is held in position when stepped by a transverse pin. Shrouds or stays are made from ⅛-in. steel cable and fitted with turnbuckles. When rigging the craft, draw the stays only moderately tight. This precaution allows the leeward stay to go just slightly slack when in use, which gives better control of the sail and prevents any undue strain on the mast. Unbleached





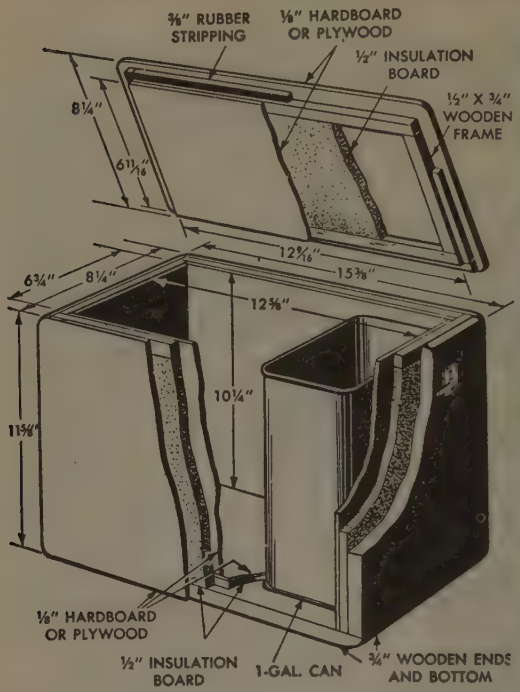
muslin is the most satisfactory material for the sail, but any available cloth will do if not too heavy. Strongly sewed hems receive mast and boom. The boom folds against the mast when not in use, and the sail is wrapped around both parts. The ferrule at the peak is simply an iron ring with holes drilled to receive screw eyes. These may be turned into the wood, or the ferrule can be drilled and tapped, and threaded eyes turned into the ring only. An eyebolt passing through the mast and a heavy screw eye turned into the end of the boom make the gooseneck. The sheet may be rigged on the right or left side, to suit the skipper. Finish the wood in natural color, using a clear sealer and two coats of spar varnish. Decorations in colored enamels can be added, using the black accents as a pattern.



ICE BOX

You need have no worries about food spoilage at your camp if this ice box is used. The secret of its efficiency lies in its adequate insulation and close-fitting lid, which has an air-cooled top as further protection if the box must be exposed to the sun on an open porch. Construction is simple. The only extra precaution necessary is to see that the lid fits perfectly. Note that the sills "A" are nailed flush with the bottom, and the corner pieces "B" and "C" rest on them. After filling the hollow walls with insulating board and crumpled paper, the piece "D" is applied to seal the compartment. Do not shred the paper, but tear it in half sheets so that air pockets will be formed.

Cans Form Liner for Inexpensive Picnic Icebox



Featuring the use of three standard 1-gal. containers to provide a ready-made metal liner, this neat little icebox is just the thing to keep your picnic beverages cool. Insulated with soft composition board, the box is lined inside and out with tempered hardboard, the ends and bottom being made of wood. Actual dimensions are determined by the size of the cans. Sponge-rubber stripping is used on cover to make tight seal.—Robert Hoppough, Waukegan, Ill.

Above, removable open-top cans, one of which contains ice, keep inside of box dry. Below, cover is held securely with a strap and buckle

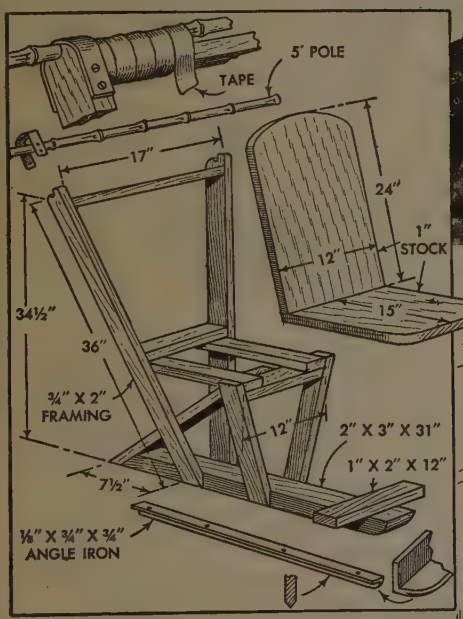
Ice-Cream Mix Frozen Quickly By Using Home Freezer

In making ice cream, the use of crushed ice and salt can be eliminated by suspending the ice-cream mix in a home freezer. Remove the ice container from an electric ice-cream freezer and fit the mixing unit into a wooden frame. Then, assemble the unit with the container in place, remove one of the covers from the home freezer and place the unit in the freezing compartment while mixing.

Harrow Disks Make Ice Planer To Surface Skating Pond

For removing skate marks or other roughness from the surface of a skating pond, one ice enthusiast found that a number of discarded harrow disks, bolted to a heavy plank, made a planer that would do the work. The device can be pulled by hand or towed behind an automobile.

ICE SCOOTER



Pushed by two skaters, this lightweight scooter skims over the frozen pond to give its passenger a swaying ride. The frame is so sturdily braced that it will support even a heavy person safely, and the single angle-iron runner, which is rounded at the forward end and beveled along the lower edge as shown, is designed to slip over the ice with the least possible friction. A bamboo pole for pushing the scooter is set in notches in the corner posts where it is held with galvanized-iron straps and tape.

Ice Skates Protected From Rust When Stored in Plastic Bag

When storing ice skates for the summer, put them in a plastic bag of the type used for storing fresh fruits and vegetables in a home refrigerator. The bag will not only prevent rust from forming on the blades, but will prevent the shoe leather from drying out.

ICE-SKATING RINK

Whether it's a 10 by 20-ft. pond for tiny tots on their "double runners" or a large-size rink for adults, the whole family will enjoy a skating rink which can be made in the back yard or on a vacant lot. If the rink is prepared in the fall before the ground freezes, the pond area can be banked by one of two methods. One way is to enclose the area with 2 by 8 or 2 by 10-in. planks set on edge and staked to hold them in position. The other method is simply to bank the pond area with earth. If the ground already is frozen, well-iced snow banks will effectively confine the water within the rink area. These banks are built up as flooding and freezing of the pond progresses. The flooding is done with a fine spray so that not too much water collects in any one spot. The ice should be built up in layers, allowing time for the first application of water to freeze solid before the next one is applied. A heavier stream of water may be used as the crust of ice becomes more solid. However, do not use a stream heavy enough to wash away the base or collect in pools and leak through holes in the crust. If snow is on the ground, this should be packed with a lawn roller before flooding. Sometimes it is advisable to roll the rink again after the crust starts to harden. After the ice has built up to a thickness of ½ to ¾ in., a good surface will begin to form. At this time the rink is filled, or leveled. Some of the low spots in the ice probably will contain small holes up to about ¼ in. in dia. These should be packed with slush to make them watertight, and the whole area sprayed with a film of water. After the film freezes, the low spots in the surface are filled with water and allowed to freeze solid. This procedure is repeated until the surface is fairly level. During the filling operation, pay special attention to the banks to make sure that they are solid enough to prevent the escape of water in case of a thaw. The pond is finished by spraying until the surface becomes as nearly level as possible. The maintenance of a rink, of course, depends on weather conditions and the amount of use. It should be resurfaced as required to prevent the formation of holes and to keep the surface in good skating condition. This also is necessary to keep the base watertight.

INBOARD MOTOR

ALL THE FUN of piloting an expensive inboard boat can be yours by powering your skiff, rowboat or outboard with an air-cooled engine of the single-cylinder utility type. These efficient little engines are self-contained units and require no conversion for inboard mounting in any open boat under 16 ft. in length, and their availability in sizes ranging from ½ hp. up makes them suitable for inboard mounting in hulls down to 7 ft. in length. Several of the larger engines are supplied with special marine equipment, including a clutch and reverse gear. A 2 to 3-hp. engine will handle a 12 or 14-ft. boat at good cruising speeds in quiet water.

Installation of the engine in the average open boat usually is quite simple. There are no fuel or water lines to plan and install and no battery to be mounted, therefore all that is necessary is to bolt the engine to suitable bearing blocks attached to the bottom of the boat. A typical installation in a small flat-bottom skiff is shown in the lower details on the following page. Before the engine is placed, several points should be considered. An air-cooled engine should not be installed under a deck or behind a bulkhead, as it will quickly overheat. Neither should it be placed in a well or compartment. Many users install the engine at the center of the boat, or slightly forward of midships, depending on the location of the seats, and operate it without any cover. The only disadvantage in this type of installation is that the unprotected engine may be drowned out during a sudden rain squall, or stop at a critical moment should water be shipped in rough weather. A recommended type of protective covering is shown on the following page. Screened openings at the front and back permit free circulation of air and a hinged cover over the top protects the engine from rain and driven spray, while permitting easy access to the starting cord. The covering, or hood, which is designed to lift off quickly when making repairs or adjustments, is attached with small hooks to a frame built around the engine.

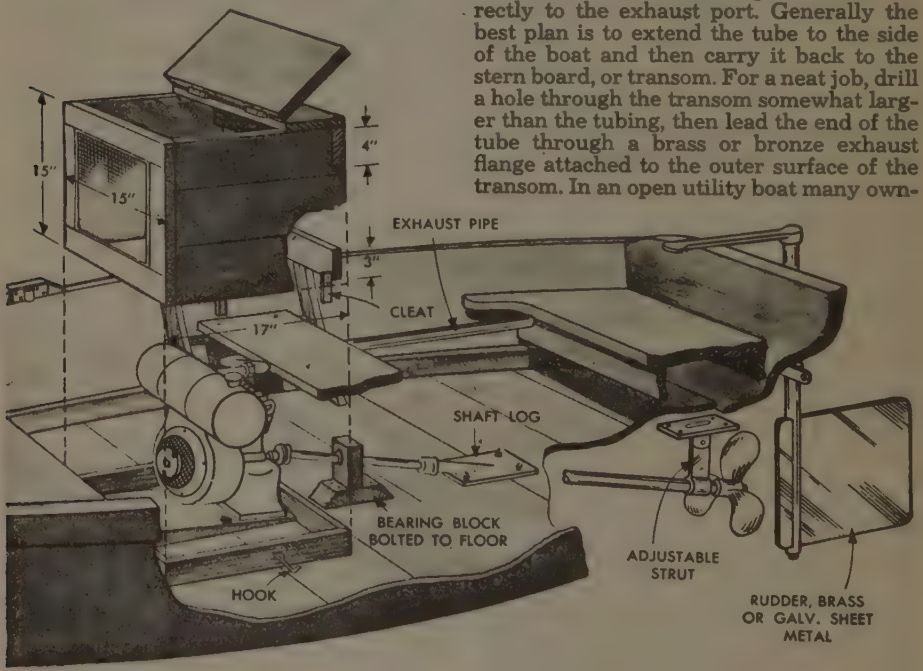
Nearly all small engines of the air-cooled type will operate satisfactorily when tilted at an angle of 10 deg. A greater degree of tilt usually is not advisable. For this reason it will be necessary to connect the engine to the inboard end of the propeller shaft

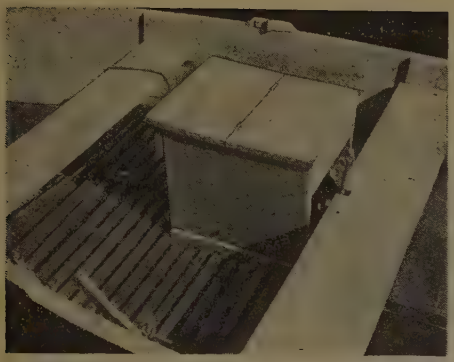
In some installations a rigid shaft log will serve the purpose, but usually the adjustable type is best

In many instances the engine can be bolted directly to the floor of boat without using tapered timbers

with a marine-type flexible coupling. On most small boats it is advisable to use a self-aligning shaft log and adjustable propeller strut. Some small boat hulls will permit fitting a skeg which can be drilled lengthwise for the propeller shaft. When mounting the shaft in a skeg, some builders simply fit the outer end with a nonscoring, or cutless, bearing. However, it usually is better to carry the underwater end of the shaft in a flange-mounted stuffing box. When obtainable, it is advisable to use a monel-metal propeller shaft. The cutaway view below shows the shaft mounted in a rigid shaft log and fitted with an improvised inboard bearing. In flat-bottom boats this type of installation generally proves satisfactory, although in some cases an inboard strut will provide a steadier mounting for the shaft.

In a pleasure boat, some means of leading the exhaust to the side or stern of the boat is desirable. Usually a length of gas-tight flexible tubing will serve the purpose. When tubing is used, the regular muffler is removed and the tubing connected directly to the exhaust port. Generally the best plan is to extend the tube to the side of the boat and then carry it back to the stern board, or transom. For a neat job, drill a hole through the transom somewhat larger than the tubing, then lead the end of the tube through a brass or bronze exhaust flange attached to the outer surface of the transom. In an open utility boat many own-





Top of the engine cover or hood should be hinged for easy access to starting cord. Note the open ends

This hood is screened on all four sides, permitting ample circulation of air to the engine cooling fan

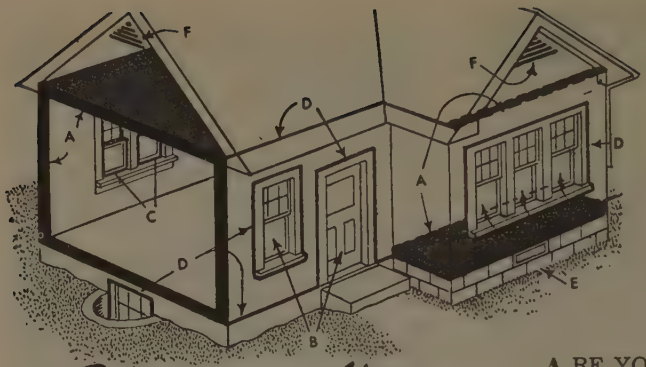
ers either omit the exhaust line entirely or install one made from ordinary pipe. In any case be sure that the exhaust line does not touch the wood at any point along its length. Wrap the pipe with several layers of sheet asbestos at the point where it passes through the transom.

A rudder of the tiller-controlled type, shown in the detail on the preceding page, is available as a unit from marine-supply dealers. Ordinarily the rudder size should be about 10 x 12 in. and it can be installed on the outside of the transom, or inboard, as desired. Rope-and-drum steering units often are installed in place of the tiller. Two-bladed bronze propellers of the general-purpose type are quite often used in inboard installations. For small engines, the propeller size can range from 6 to 10 in. depending on the power of the engine and the size and type of the boat. Always carry a pair of oars for emergencies. ★ ★ ★

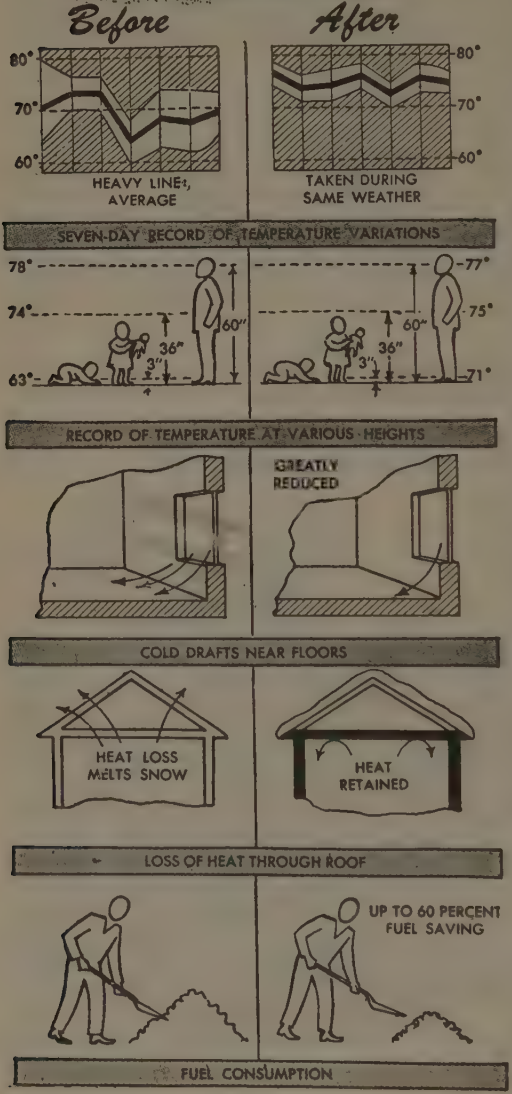
INCINERATOR

Movable Back-Yard Incinerator Is Easily Wheeled Out of View

If an incinerator must be set up where it spoils the appearance of your back yard, you can get rid of the eyesore by using this portable incinerator. Keep it tucked away alongside the garage or behind some concealing shrubbery and just wheel it out whenever it is needed. The unit is made by bolting or welding a section of oil drum on a pair of old hand-truck wheels. The latter or a satisfactory substitute often can be obtained at the local junk yard. A grate is installed in the drum about 6 in. from the bottom and a hole is cut in the side below the grate to provide sufficient draft. The hole also permits access beneath the grate for removing ashes. Pipe or flat-iron handles are bolted to the sides of the drum and, if desired, a lid can be fashioned from wire mesh or sheet metal.



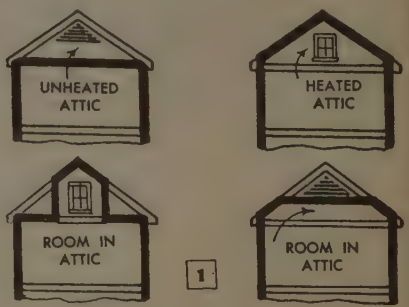
A—Insulation and vapor barriers; B—Storm sash and doors; C—Weather stripping on all sash and doors; D—All cracks calked; E—Wall encloses unheated space under floor; F—Vents above ceiling insulation



ARE YOUR heating costs running too high and is it difficult or impossible to heat your home comfortably and uniformly in cold weather? In older homes installation of storm sash, weather stripping, and insulation and calking can reduce heat losses through the walls, ceilings and windows of the structure as much as 60 percent. Aside from the substantial saving, you will have a more comfortable, healthful home.

Insulation: Insulating values of different types of wall construction are given in Fig. 3, details A to J inclusive. Good insulating materials, properly installed, will last the life of the building and are resistant to fire, moisture and insect attack. There are four basic types, or kinds, of insulation — the loose-fill type, flexible batts, blanket and quilted forms, and the rigid-board and reflective metal-foil types. Many porous insulating materials are faced with a vapor barrier. Others require the installation of a separate barrier to prevent the passage of moisture.

Where to insulate: About 25 percent of the heat loss from the average uninsulated house is through the roof. Snow melts quickly from an uninsulated roof, even though the temperature is well below the freezing point.



INSULATION

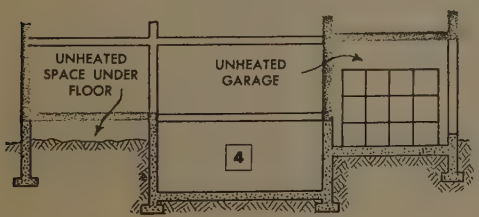
If it is desirable to insulate only a part of the house at one time, start with the top-floor ceiling or the roof, Fig. 1. Note also the details above and at the left. If you don't need a heated attic, insulate the ceiling, Fig. 2; if a warm attic is desired, insulate the roof. Rooms built in attics should be insulated above and on all sides facing unheated spaces. Next in importance to the roof or ceiling are the exterior walls. Include walls that separate living quarters from unheated spaces such as an attached garage or an attic stairway. Also insulate floors over unheated spaces such as garages, basements and the areas between the ground and floor as shown by Fig. 4.

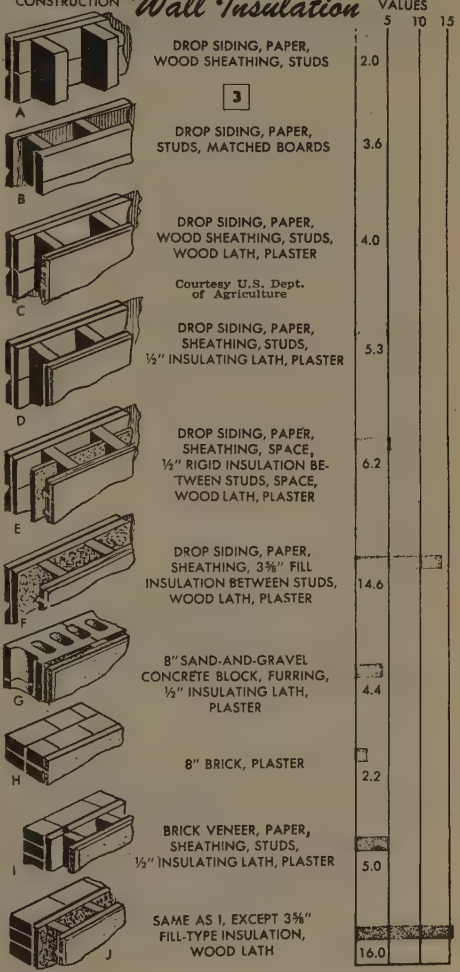
2

Courtesy Celotex Corp.

Importance of vapor barrier: If you live where the average January temperature is 35 deg. or less, condensation of moisture may occur if you insulate without vapor barriers. Moisture-laden air inside the house slowly penetrates the plaster and insulation and condenses to water or ice when it comes in contact with the cold inner surface of an exterior wall or roof, Fig. 6, A. Results of condensation are rotted wood, peeling paint, damage to inside walls and ceilings, and damage to insulation. To prevent this, install vapor barriers between the insulation and the heated interior of the house, Fig. 6, B. A vapor barrier may be a membrane (such as asphalt-saturated paper or felt, metal foil and waterproof wall covering) or simply vapor-resistant paint (such as aluminum paint, most lead-and-oil paints and spar varnishes). Ordinary tar paper and roofing felts are not suitable for this purpose. Insulation faced with vapor-barrier coverings, Fig. 5, can be installed directly between the studs or joists. The vapor barriers should also be used where air from a basement or crawl space can get into walls and pass upward to the attic. Walls of attic stairways must not be overlooked, and doors to attics should be weather stripped, painted or varnished, and sometimes insulated, too.

Venting spaces over insulation: When you insulate, be sure to ventilate the space





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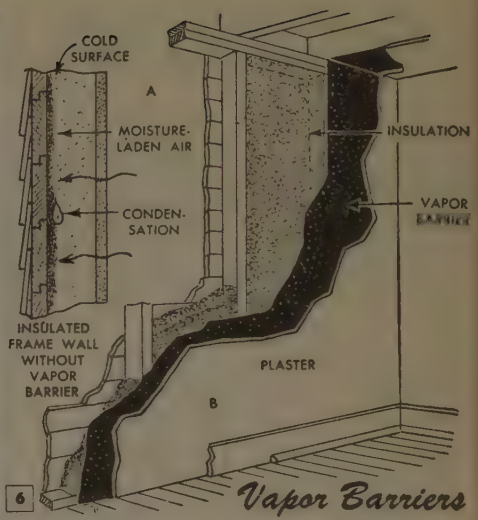
Courtesy United States Gypsum Co.



6

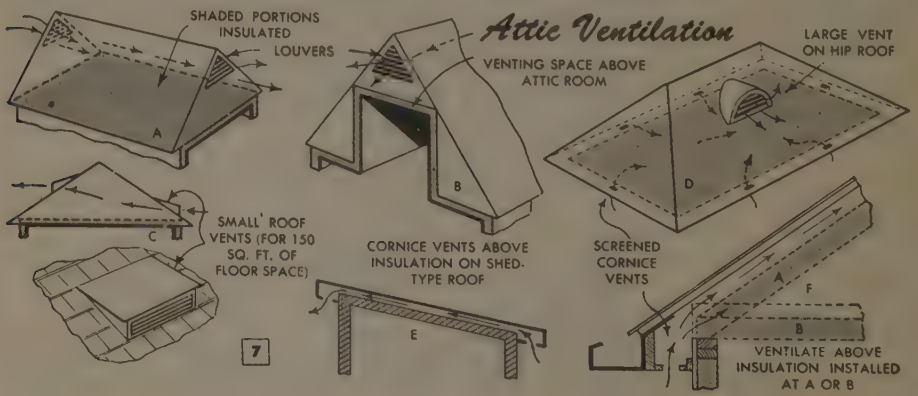
Vapor Barriers

above insulated ceilings to minimize condensation on the underside of the roof. Fig. 7, A to F inclusive, shows several methods of doing this with louvers, roof vents and cornice vents. The area of the vents should be equal to at least 4 sq. ft. for every 1000 sq. ft. of attic floor area.

How much insulation? More insulation is needed in homes where winters are severe than where the climate is mild. For best results the thickness of insulation will depend on the kind of insulating material, the house construction, inside temperature to be maintained and other variable factors. It's best to consult a reputable dealer or contractor in your community who can advise you concerning the kind and quantity of insulation to install.

Loose fill: Loose-fill insulation comes in bags or bales. To cover a ceiling first install a vapor barrier, if necessary, directly on the ceiling. Cut the barrier to fit snugly around all obstructions to minimize air leakage. Wedge it between joists or attach it to them with cleats nailed to the joists as in Fig. 8, A. Pour in the fill to a 4-in. thickness, Fig. 9, distributing it evenly with an improvised strike board that straddles the joists, Fig. 8. If the attic is floored, remove some of the floor boards, Fig. 8, B, so that the material can be distributed uniformly. If the area is finish-floored, it will be necessary to have a contractor blow the fill in. When this is done use water-resistant paint or wall covering on the underside of the ceiling to serve as a vapor barrier, if the climate requires it.

Insulating frame, stucco or brick-veneer walls of existing houses with loose fill generally is a job for a contractor as he has the equipment required to blow in the material as in Fig. 11. Strips of siding or other wall covering are removed temporarily and holes bored in the wall sheathing, Fig. 10.



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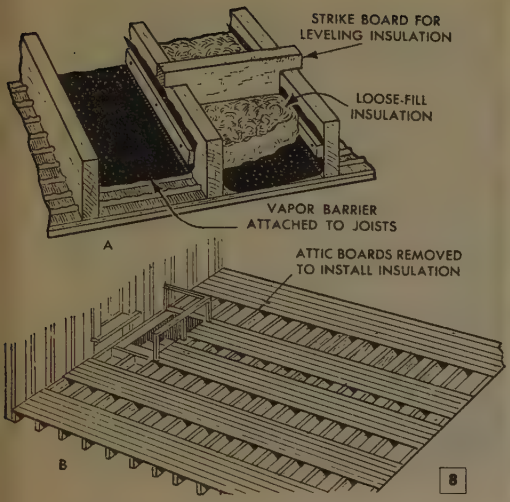
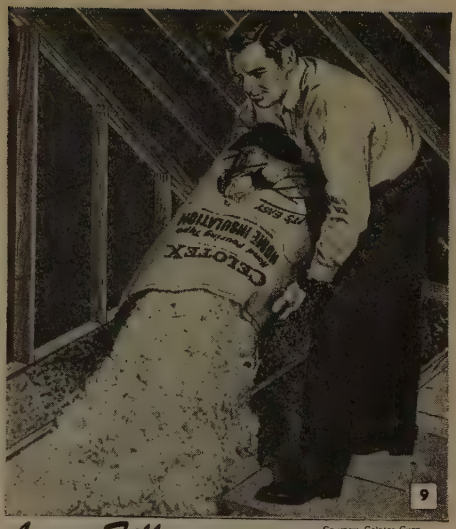
Attic Ventilation

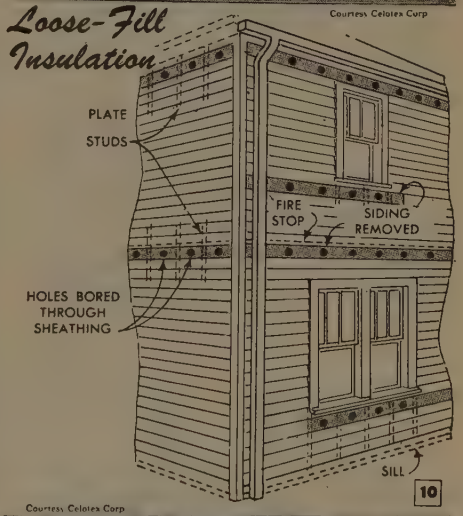




Courtesy Celotex Corp

Be sure that all spaces are filled, including those under windows and fire stops.

Flexible insulation: Insulation in the batt, blanket and quilt forms comes in widths that fit snugly between studs, joists and rafters, and in lengths up to 48 in., or in rolls up to 100 ft. The thickness varies from ½ to 3⅝ in. When using flexible insulation, cut it to fit snugly around obstructions, placing it with the vapor barrier facing the inside of the house. Fill all spaces and push the ends of the batts together snugly. When insulating a sloping roof with batts or blankets, start at the eaves and work up as in Fig. 12. Make U-shaped barrier pockets to seal the spaces between rafters where they join the plate, tacking the pockets to the plate and to sides of the rafters as in Fig. 13, A. The lower end of the insulation fits in the pockets, which may fit tightly against the roof boards unless air is circulated from cornice vents. In this case space is left above the pockets and batts as shown in Fig. 13, B, and at A and B, detail F, in Fig. 7. The air space at B is left when only the floor is insulated. Detail C, Fig. 13, shows how quilt-type insulation is fastened with strips to the plate and rafters. If the vapor-barrier facing on batts has flanges at the ends, these should overlap each other. The side flanges are tacked or stapled to the rafters. Where a portion of the roof serves as a room ceiling, the wall covering will come directly against the vapor-barrier facing of the batts as in Fig. 13, D. When installing flexible insulation in walls, start at the bottom, filling all spaces between studs, and cut the batts or blankets as



Courtesy Celotex Corp

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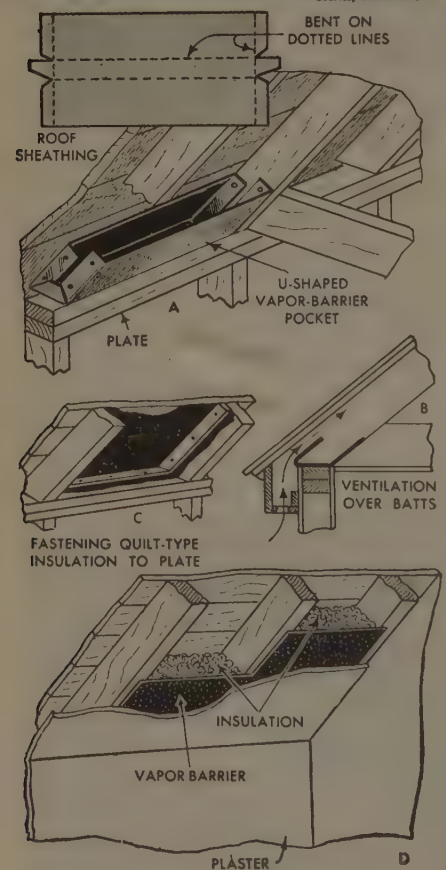
Courtesy Celotex Corp.

Courtesy United States Gypsum Co.



13 *Flexible Insulation*

necessary to fit snugly into corners and against obstructions. If you encounter water pipes in exterior walls, place the insulation between them and the sheathing.

Rigid insulating board: When remodeling or adding a room in an attic, you have the opportunity to use rigid insulating board, Figs. 14 and 15. It also has a structural value, some forms being used as sheathing, some as a plaster base, and others having a finished surface to serve as a wall covering. The board ranges from ½ to 1 in. in thickness and comes in sheets 4 ft. wide and up to 12 ft. long. It also is available in smaller panels or in squares. The edges of panels or squares may be square, beveled, rabbeted or tongue-and-groove. Small panels are arranged horizontally and are staggered so that the joints of adjacent rows come on different studs as in Fig. 15, A. As the panels usually have interlocking edges, no horizontal nailing supports are needed between studs. Large sheets should extend from floor to ceiling as in Fig. 15, B. When shorter sheets are used, cross supports for nailing are necessary. Nail sheets to the center supporting studs first then at the edges. Space the nails 4 to 6 in. apart and about ⅜ in. from the edges, using special nails available for the purpose. When rigid insulating board is used between studs, joists or rafters, it is cut to fit snugly and nailed to 1-in. strips. It also is used under floors—either subfloors or finish floors—leaving a ⅛-in. space between sheets to allow for expansion.

Insulating masonry walls: To insulate a masonry wall, first coat it with asphalt dampproofing compound. Then nail the insulating board to 1 x 2-in. furring strips spaced 16 in. on centers as in Fig. 16. Use

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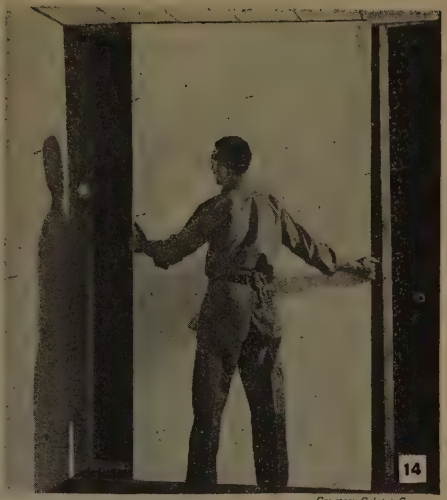


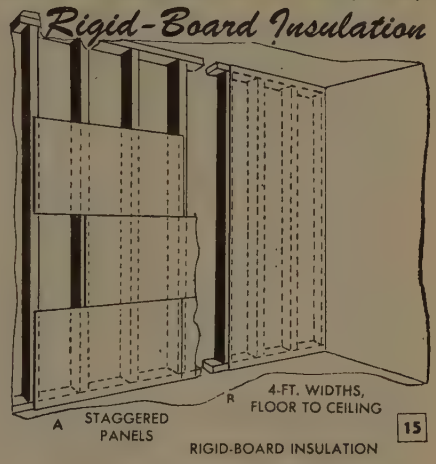
Courtesy Celotex Corp

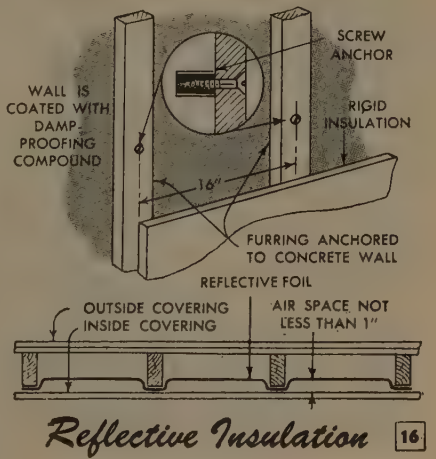
expansion sleeves or other screw anchors for attaching the furring strips to concrete. Thin blanket insulation can be inserted between the strips before attaching the board to obtain added insulating value.

Reflective foil: Reflective foil comes separate or as a facing on other forms of insulation and also as a facing on plasterboard. In insulating value it is roughly equivalent to ½-in. insulating board when exposed to an air space not less than 1 in. wide, Fig. 16. The foil also is an effective vapor barrier. Since it does not absorb heat like other forms of insulation, it is particularly useful in warm climates. Several sheets separated by air spaces also may be used. A small amount of dust on the foil does not greatly reduce its reflective power.

Storm sash: A properly fitted storm sash provides a dead-air space between it and the regular window, which acts as insulation. Tests at the University of Illinois have proved that a 20-percent fuel saving is possible in most homes when they are completely equipped with tight storm sash and storm doors. Another result is a 1 to 2-deg. temperature increase at the floor level. Besides saving heat, storm sash reduces condensation on windows.

If you cannot equip the entire house at one time, start by installing storm sash on the sides facing the prevailing wind direction. The inside surface of storm sash should fit tightly against the blind stop of the window casing, Fig. 18, but the sash should have ⅛-in. clearance around the edges, detail A, to compensate for swelling. If surface irregularities of contacting surfaces of sash and casing prevent a tight fit, you can seal the joint by using felt or sponge-rubber strips glued in a rabbet cut





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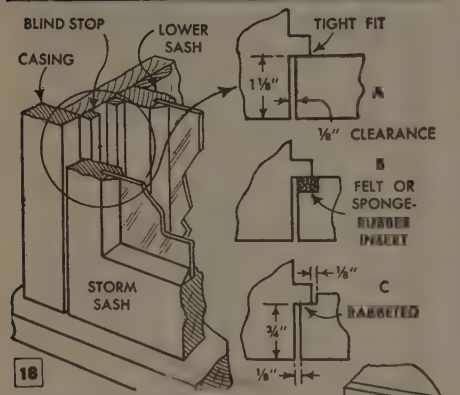
along the edge as in detail B. Edges of 1⅛-in. sash frames are rabbeted to make them fit old-style ¾-in. casings, as in detail C. Storm sash for double-hung windows is available in full length or in sections, Fig. 19. Divided sash can be passed through a window and hung from the inside of the house, eliminating the need of a ladder. To hold storm sash in place, use sash hangers at the top and hooks and eyes at the bottom. Where ventilation is desired, use sash adjusters to hold the sash open or lock it when closed. As an alternative you can use ventilating openings in the lower rail.

The metal-framed storm sash for metal casement windows are applied from inside, Figs. 17 and 20. As they generally cover individual window sections only, they do not stop condensation on the frames. To prevent this you can use a wooden sash to cover the entire window as in the right-hand detail of Fig. 20. The use of dual panes in windows as a substitute for storm sash is effective in reducing heat loss by conduction but does not prevent air leakage at the edges of the window frame or stop condensation on the frames.

Weather stripping: Many kinds of fabric, felt and rubber weather stripping are subject to wear and shrinkage which gives them only temporary value. Fig. 22 shows how to apply various kinds to a double-hung sash. Metal weather stripping, available in various widths, is easy to install and is permanent. Exposed ends are bent back slightly to avoid catching in the wood when the sash slides over them. Fig. 23 shows how this type of weather stripping is installed on a doorframe. Note that it is cut



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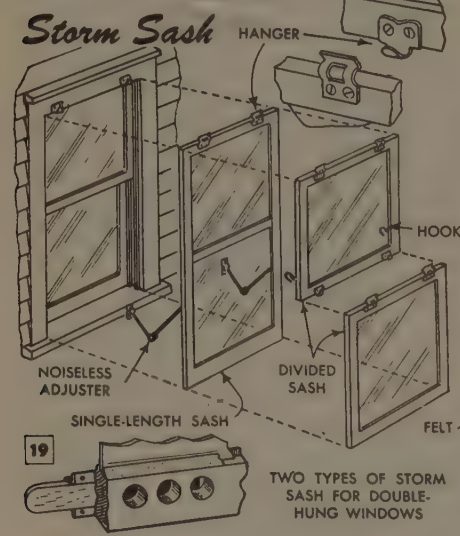

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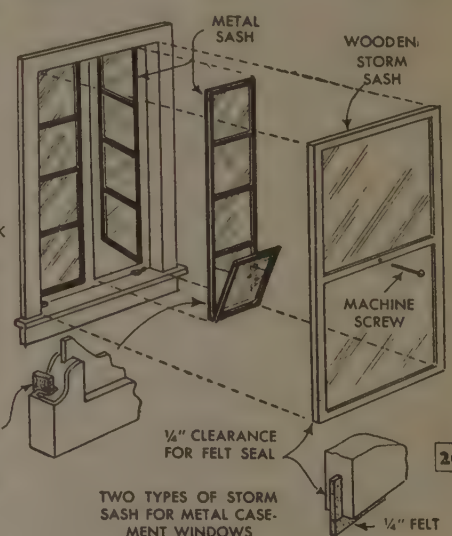
TWO TYPES OF STORM SASH FOR DOUBLE-HUNG WINDOWS



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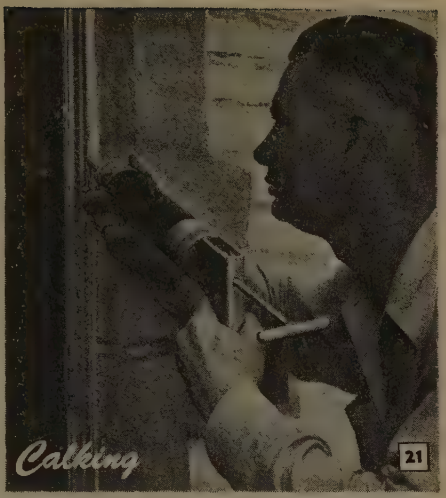
TWO TYPES OF STORM SASH FOR METAL CASEMENT WINDOWS

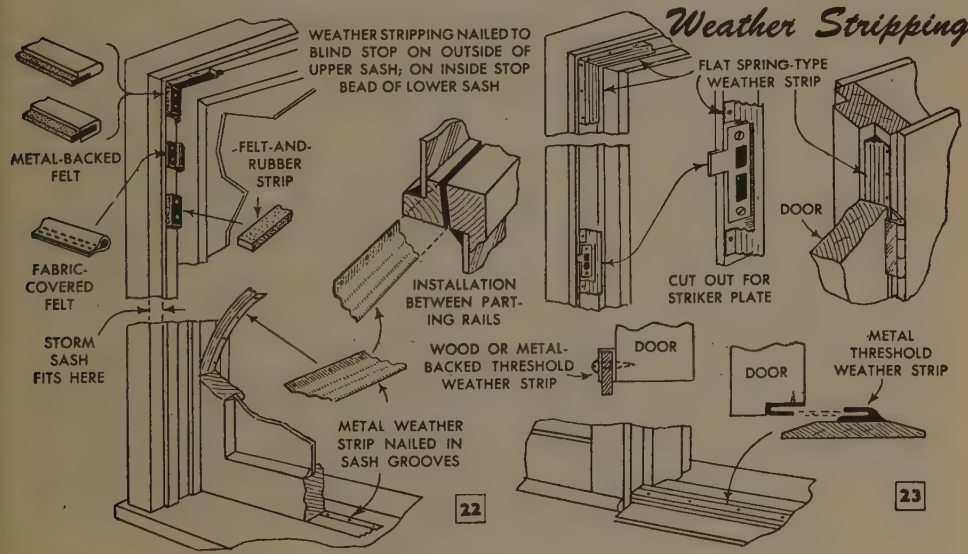
away at the striker plate. The threshold can be fitted with a wood or metal-backed felt weather strip but, for appearance and durability, a rigid metal weather strip consisting of two interlocking members is preferable. On wooden casement windows, felt or fabric weather strips go on the outside, but the flat-metal type is fitted in the same manner as on doorframes. If necessary, dress down edges of tight-fitting sash to provide clearance for the strips. On metal casement windows, the metal-framed storm sash usually has felt inserts which provide a tight seal and thus serve as weather strips. You can seal metal sash, however, by gluing rubber tape to the frame all around, using automotive rubber cement.

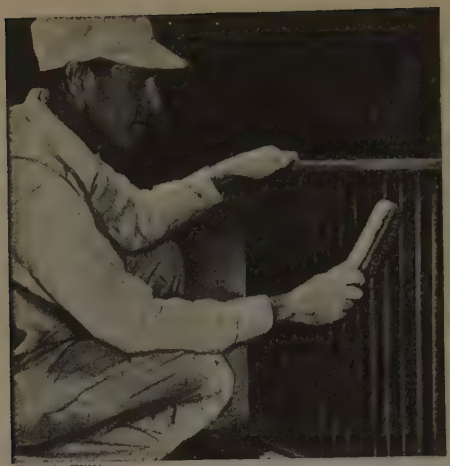
Calking: A fairly high percentage of heat is lost through spaces at window and door frames and through cracks at points where walls join roofs and foundations, or where pipes and conduits pass through walls. To reduce this loss fill narrow cracks with calking compound, using a calking gun as in Fig. 21 which forces the compound deeply into the cracks by pressure. Before calking, brush out loose particles of dirt from the crevices. Don't use the compound alone to fill wide cracks and openings as it will shrink and pull loose. Wide spaces must first be packed with oakum or jute before calking. Hammer this tightly in place with a blunt-edge tool so the filling is almost flush with the opening but leaves enough space to take a layer of calking compound as a final seal.

Curtain walls: If you have a basementless home built on piers instead of on a solid, continuous foundation and cold

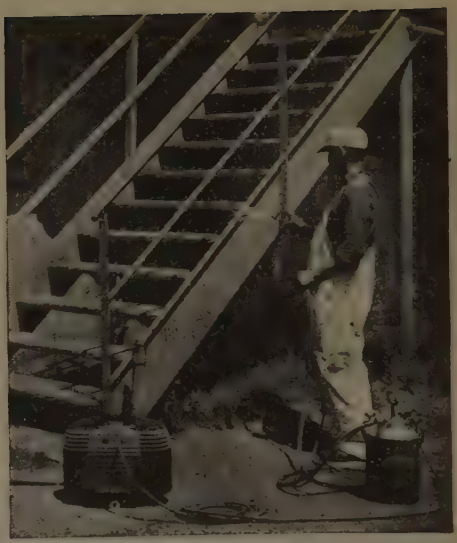


weather makes the floor uncomfortable, a curtain wall may be the solution to the problem. This should have vents for cross circulation during warm weather and, if necessary, be provided with an entranceway. In cold climates both a curtain wall and adequate insulation under the floor are necessary. When batts or blankets are used between the floor joists, the vapor barrier should be laid face up. The batts can be given added support by nailing wallboard or wire mesh to the underside of the joists. Floors of basementless houses need not be insulated if the heating pipes or ducts pass through the crawl space, or if the space is insulated on all sides. ★ ★ ★





Sherwin-Williams



Loose rust should be brushed off with a steel-wire brush. Right, red lead is a popular primer for all outdoor iron; easily sprayed with pressure-feed gun

IRON FINISHING AND REFINISHING

THE PRIME enemy of outdoor iron is rust. A coat of paint applied when the iron is new and renewed regularly will keep the metal from rusting. Once rusted, a coat of paint will not stop rusting unless it is a rust-inhibitive type. However, any kind of paint will slow down the rusting process.

Primer coat: All outdoor iron and steel should be given a coat of rust-preventing primer. Ready-mixed red-lead paint is commonly used for this purpose. It can be obtained in a variety of grades, with drying time from 4 to 24 hrs., and in various tones of red from dull brick to bright orange. If the color is satisfactory, red-lead paint can be used for the complete finish. Where a change in color is desired, any quality house paint can be used over the red-lead primer. Blue lead is blue-gray in color and is sometimes used instead of red lead for a one-coat neutral-color job.

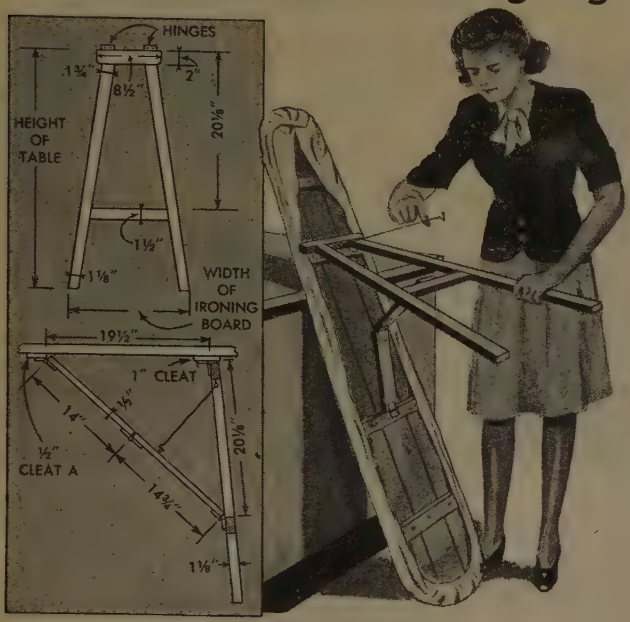
Galvanized iron: New galvanized iron cannot be successfully painted with red lead or other common primers. The iron must weather about nine months before it can be so painted. When it is desired to paint new galvanized metal immediately, good bonding can be obtained by using special primers made for this purpose. A popular type is zinc dust. This comes in a two-compartment can—zinc dust and vehicle—and is mixed immediately before using. The neutral gray color is satisfactory for a finish coat in many instances; if not, the work is topped with any color of outside house paint.

Ornamental iron: Ornamental iron is usually painted black over a red-lead primer. Good black primers are also available. Iron blacks are available in both dull and gloss, and you have to decide yourself which to use. Gates and heavy iron are usually satisfactory in gloss, while lanterns and sheet-metal designs look best with a flat finish.

Lawn furniture: Clean up the old finish by sanding rust spots and washing the whole piece with a good household cleaner. Rinse with clear water. When dry, paint with any outdoor enamel—be sure it is exterior grade or suitable for outside exposure. Don't use an outside house paint as most of these are formulated to chalk when weathered and will rub off on clothing.

Rust removal: All loose rust should be removed with a wire brush. If rusting is not excessive, red lead can be used as a primer after removing the worst of the scaling. If rusting is bad, it is best to use a first coat of special penetrating rust preventer as a first coat. Materials of this type combine with the rust, bond it to the solid metal and inhibit further rusting. A rust preventer of this kind should be topped with a regular metal primer such as red lead. For faster work, rust preventer can be mixed with read lead at the rate of a half pint per gallon of paint and the combined mix applied as one coat.

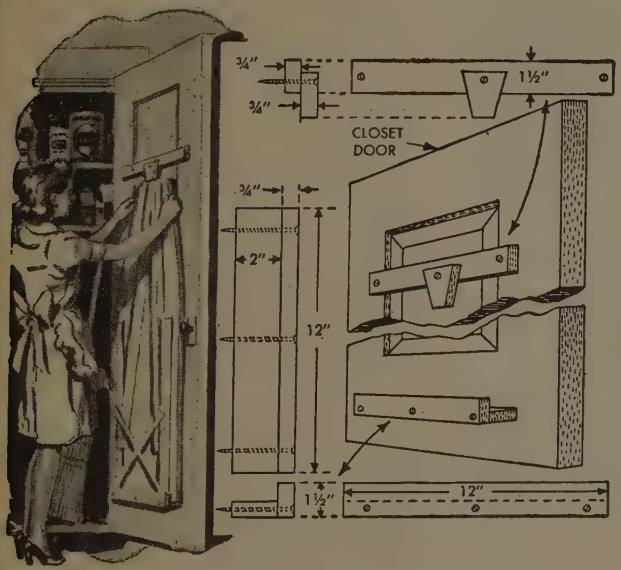
Ironing Board With Folding Legs Is Made Easily



Permanently attached to an ironing board, this half stand unfolds to support one end of the board while the other end rests on the edge of a table, counter or laundry tub. The board can be made from odds and ends of lumber, five hinges and a short length of stiff wire. The pieces of the leg assembly may be joined with screws, dowels or tenons. If the dimensions given are followed, the stand will fold flat against the board. To allow for final adjustment, cleat A should be mounted after all the folding members have been joined. A hook made from stiff wire holds the leg brace in position to prevent the stand from collapsing under heavy pressure.

Aluminum Foil Speeds Ironing

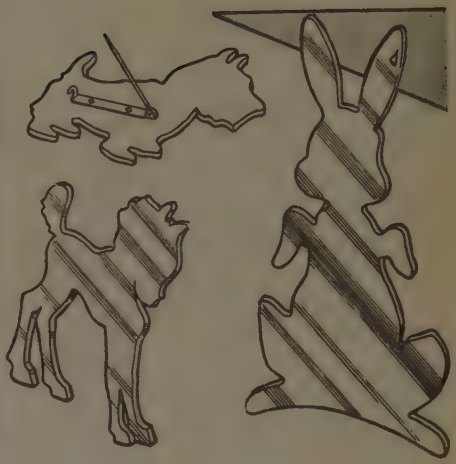
Spreading a sheet of aluminum foil over the ironing-board pad before tying down the cover speeds ironing considerably. The metal keeps the moisture in sprinkled clothes, reflects heat from the iron and thus helps to produce steam.

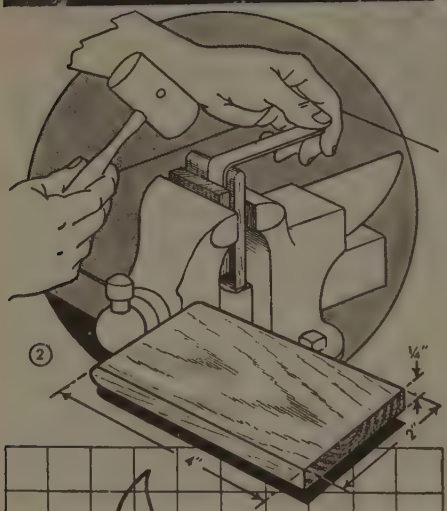


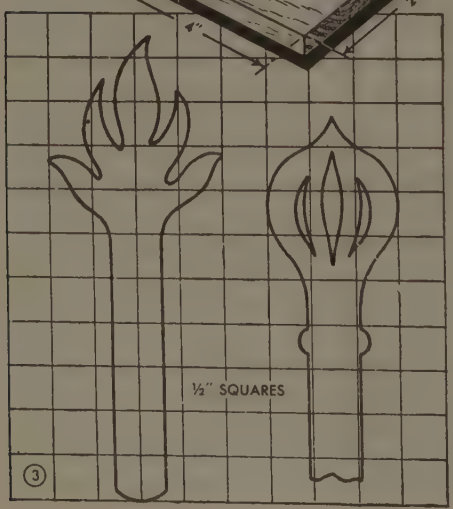
Ironing Board Holder

With this on-a-door holder it's easy to keep an ironing board in place. The base, which supports the board, is made according to the dimensions in the detail, although it may be necessary to alter them to fit some ironing boards. The manner in which the upper cleat is made is shown in the upper detail. Some boards are constructed in such a way that the legs won't stay up if they face out from the door when placed in the holder. In this case the legs should rest against the door.

JEWELRY



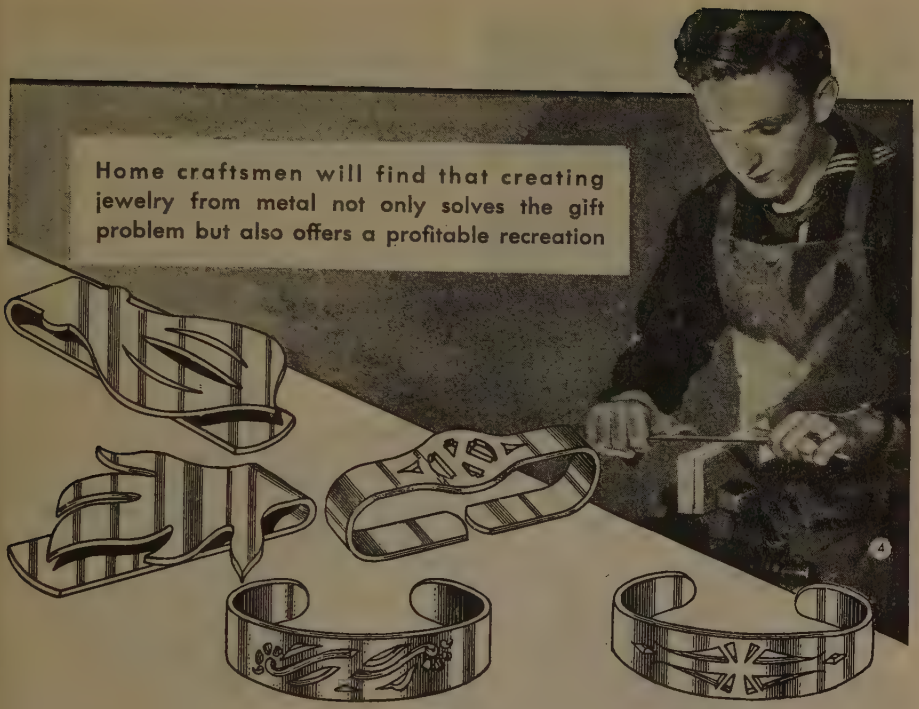




MANY attractive and unusual articles of jewelry, such as napkin clasps and rings, bracelets, pins and brooches, can be made from small pieces of sheet metal. The work is learned easily, requires only a few common hand tools and provides unlimited opportunity for originality in design. Novelty jewelry makes an ideal gift and for this reason it finds a ready market wherever souvenirs are in demand.

Materials: Half-hard aluminum, soft brass, cold-rolled copper, German silver, nickel and many other metals and alloys are suitable, the thickness, or gauge, of the metal depending on the article to be made. For napkin clasps and rings, 16-gauge metal is suitable, but for pins and other ornamental items, metal as light as 36 gauge, which is a little less than 1/64 in., can be used.

Napkin clasps: These popular and useful articles not only are the easiest to make, but illustrate the procedures to be followed in fashioning the more difficult pieces. From a sheet of 16-gauge aluminum or German silver, a strip 2 by 5¼ in. is cut with tin snips as in Fig. 13. A design such as one of those shown in Fig. 3 is drawn on paper, which is cemented to the metal strip. Shellac or rubber cement can be used as an adhesive. When this has dried, the metal is trimmed down roughly to the shape of the design, then scrollsawed to finish size. For sawing, a notched and slotted board is used as in Fig. 1. The board is clamped to the workbench and the metal is positioned so that the lines to be sawed are over the notched cutout. The work should be held firmly on the cutting board


Home craftsmen will find that creating jewelry from metal not only solves the gift problem but also offers a profitable recreation

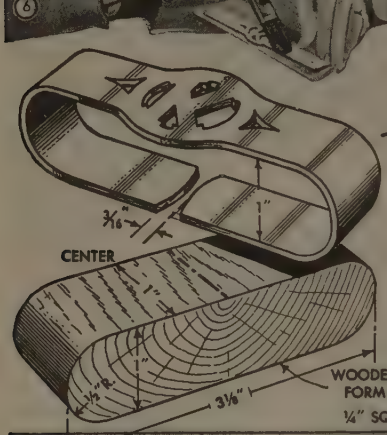
to prevent vibration while being sawed, as this may cause the blade to break. With the blade teeth pointing toward the handle, the saw is tilted forward slightly except when cutting a sharp corner. This must be done slowly to allow the blade to clear away enough stock to turn without binding or breaking. Wax rubbed on the blade will serve as a lubricant so that it will cut freely.

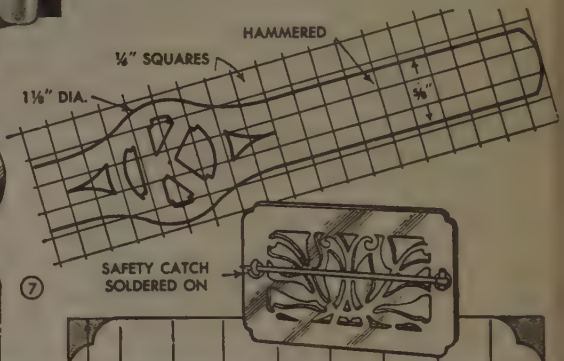
When using a design like that shown in the right-hand detail of Fig. 3, portions of the metal must be sawed out. This is done by first drilling small holes through which the saw blade can be inserted. The work is clamped between two wood blocks as in Fig. 5 so that the drill will cut through the metal without damaging the workbench. The locations of the holes should be center-punched before drilling so that the drill will not slip out of place and scratch the metal.

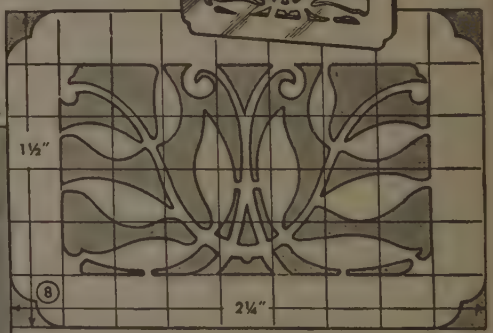
After all sawing has been done, the edges are smoothed by draw-filing. The work is held in a vise between two blocks of wood, which are placed about ⅛ in. below the edge of the work in order to give greatest support to it. A small mill file then is gripped with both hands and drawn flat in one direction only along the edge of the

metal, Fig. 4. Because aluminum and other soft metals clog a file quickly, chalk should be rubbed on the file frequently to prevent its filling up. When all edges have been filed smooth, they should be rubbed down with a strip of medium emery cloth followed by a strip of No. 0 cloth.

The metal is polished with a fine abrasive such as powdered pumice or ordinary kitchen scouring preparations applied with a damp cloth. Fine steel wool can be used to produce a dull, rich finish, but for a bright luster jeweler's rouge, or metal polish such as used on automobiles, can be applied with a felt pad. Then paste wax is rubbed on to protect the finish, or lacquer,





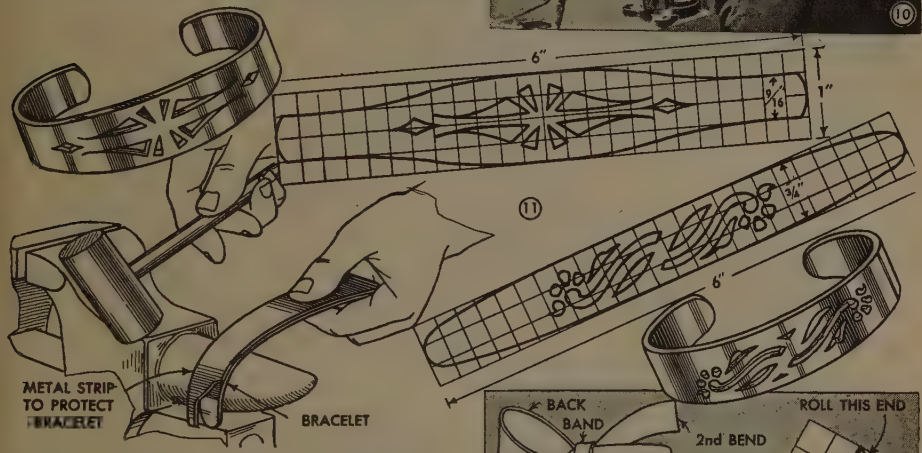


which is more durable, is applied with a small brush, Fig. 6.

To shape the clasp, the scrolled end is clamped between two blocks in a vise as in Fig. 2, the end of one block being rounded to assure a uniform curve when the metal is bent over it. When shaping the clasp push down gradually with one hand and at the same time tap it lightly with a mallet.

Napkin ring: The napkin ring, Fig. 7, is made in the same way as the clasps, although a differently shaped forming block is used. Monograms and initials, which may be varied to suit individual requirements for decorating the ring, are illustrated in Fig. 9. Before shaping and polishing the ring, its entire surface, or a

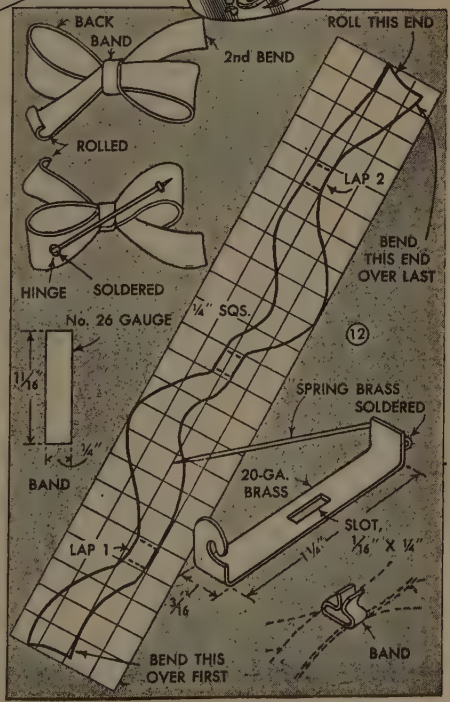
small portion of it, can be hammered to produce a pleasing effect. This is done by tapping the surface lightly with a ball-peen hammer, or by indenting the surface with a punch made by rounding one end of a short length of ⅜-in. dowel. To bend the ring, a line is marked on one side of the forming block across its center, and the strip of metal, after being scrollsawed, filed and polished as previously explained, is positioned over it so that half its length extends on each side of the line. The strip, of course, must be aligned carefully along the edges of the block so that, when bent, the ends will meet exactly. Then the strip is covered with a small wooden block and

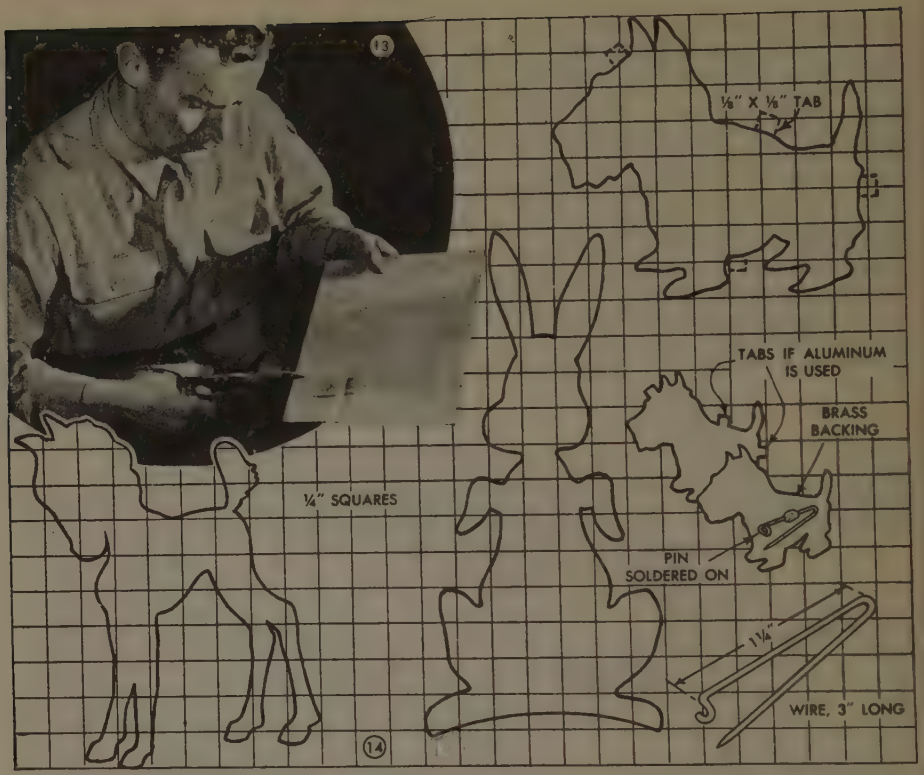


clamps are tightened over the work, after which the ends are bent and tapped with a mallet until the ring is completely formed.

Filigreed bracelets: Although they are made in much the same way as the napkin rings, the bracelets shown in Fig. 11 require a little more experience because of the intricacy of their designs and the small portions to be sawed out. Nickel or German silver is preferable to brass, copper or aluminum for making bracelets. These are formed over the end of an anvil as in Fig. 10. When doing this work, care must be taken to avoid distorting the web pieces of the design. For this reason, a thin metal strip is laid over the work to protect it while it is tapped with a mallet, as indicated in the lower left-hand detail of Fig. 11.

Pins and brooches: Several kinds of pins and brooches are shown in Figs. 8, 12 and 14. For the filigree-type brooch, Fig. 8, 20-gauge silver or German silver is suitable. When sawing metal of this thickness, it is best to use the slotted end of the sawing board shown in Fig. 1, rather than the notched end, so that the work will be well supported. If the piece buckles under the



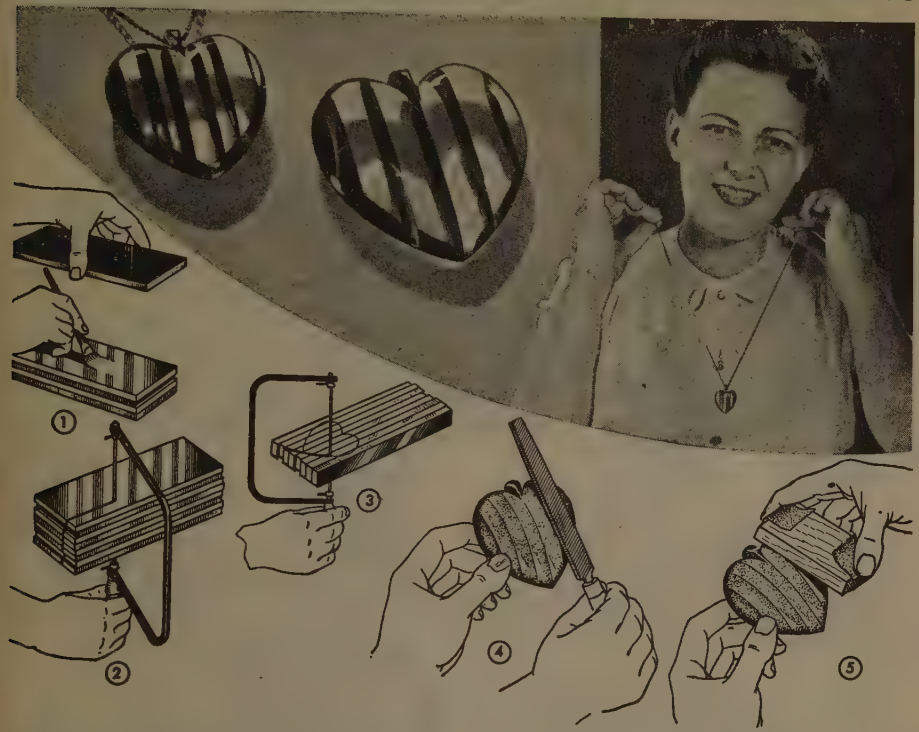


saw, the kinks may show even after the piece is straightened again, and such defects are enough to ruin the material for this purpose. A regular pin back with safety catch, available at jewelers' supply houses, is soldered on the back.

The bowknot pin, Fig. 12, is light enough to be worn on a blouse, as it is made from 36-gauge silver or German silver, which is cut with small tin snips. Before bending the cut-out strip according to the cross-hatched pattern, one side can be polished to a high gloss and the other side can be rubbed to a dull, satin finish so that, when the strip is folded as indicated in the upper left-hand details, the alternating gloss and satin finish will give a pleasing, silky appearance. After bending the strip, a band of heavier stock is wrapped around the center and soldered at the back. A pin back may now be soldered in place. If the pin is made of aluminum, a strip of brass, cut and shaped as shown in the right-hand detail, can be used instead. The brass strip is provided with a slot through which the ends of the band are slipped and peened to hold them in place.

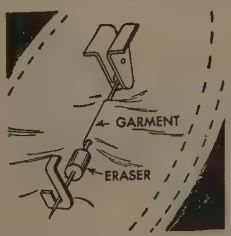
Silhouettes of animals, Fig. 14, are always popular as pins, but trees, leaves, or sketches adapted from illustrations can be used. Copper or brass is attractive, although aluminum also is satisfactory. However, if aluminum is used the pin fastening cannot be soldered to the back unless special solder is used. Instead, tabs should be provided for folding over a brass backing to which the pin can be attached, as indicated in the right-hand details of Fig. 14. If a pin back or pin mounting is not available, one can be improvised from a length of spring wire, or an ordinary safety pin may be substituted.

Striped Heart Is Built of Laminated Plastic Sheets



When viewed from the front, this plastic heart shows a few fine vertical lines of color which widen into stripes as it is rotated slowly, and when viewed from the side the heart appears to be a solid color. The blank from which the heart is cut is built up of laminations of transparent thermoplastic cemented together. The plastic sheets may be of the same thickness, or of varying thicknesses from ¼ to ⅛ in. to provide different patterns. The plastic first is washed with acetone and then the surfaces to be joined are coated with colored fingernail polish. After the polish has dried, it should be sanded with No. 400 wet-or-dry sandpaper and wiped clean. When building up the laminations, use glacial acetic acid for a binder, Fig. 1, wiping off any air bubbles. Press the sheets together with the fingers when the surfaces become tacky, but do not use clamps as this will press the polish out from between the sheets, leaving a weak color or no color at all. Allow the block to set for at least 24 hours and then cut lengthwise strips, Fig. 2, about ⅜ to ½ in. thick. Using a template with the shape of a heart, saw the rough, Fig. 3, and round with a file, Fig. 4. If a few extra minutes are spent with the filing, it will save much sanding time. Final sanding is done with No. 320 emery cloth, Fig. 5, followed by No. 400 wet-or-dry sandpaper. While any fine abrasive polish can be used, one made with a paste of tin oxide and water spread on a tightly stretched cloth works well. The heart is rubbed briskly over the cloth, rotating and turning it in the process. When the heart has the required polish, the hole for the chain is drilled with a No. 50 drill. This should be at an angle from both sides to avoid marring the polished surfaces. Polish the hole with a cotton string rubbed with abrasive.

Eraser Serves as Brooch Guard



To guard against the loss of a brooch or other ornamental pin that does not have a safety clasp, use a pencil eraser. After the pin has been fastened to the garment, the eraser is slipped onto the pin between the garment and the clasp.

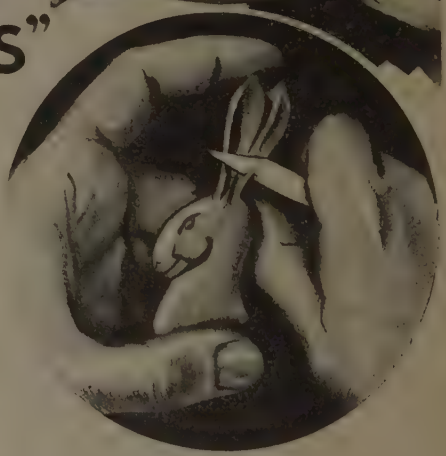
FEMININE EYES WILL SPARKLE OVER THESE

①

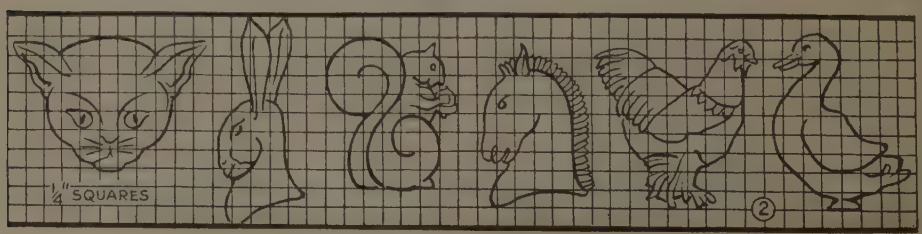
Hand-carved "LAPELLIERES"

Fifteen novel dress-pin designs to carve in wood. All you need is a coping saw, a jackknife and sandpaper

YOU'LL want to remember someone this Christmas with a gift of these smart wooden dress ornaments. They're fun to carve and not at all difficult, as the photos in Figs. 1 and 5 make it easy for you to see just where to whittle and the right contour to duplicate. Patterns for the ornaments shown in Fig. 1 are given on squares in Fig. 2, so that they can be readily enlarged for tracing on 3/16-in. stock. Hardwoods, such as maple, walnut, mahogany, cherry,



After scroll-sawing a figure roughly to size, it's easy to carve it with a jackknife and sandpaper to a smooth finish



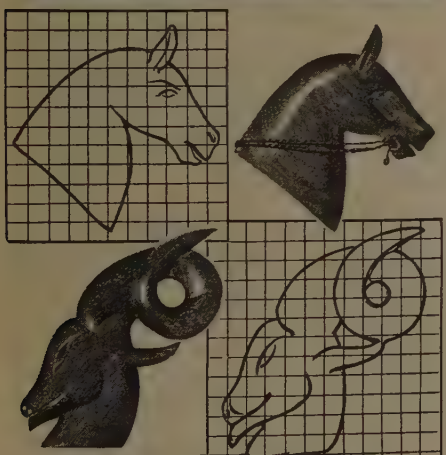
②

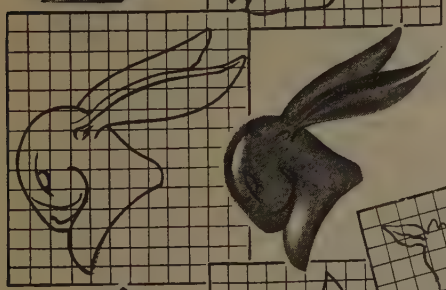
etc., are preferred to softwoods, as the cross grain is stronger and a higher polish can be had in finishing.

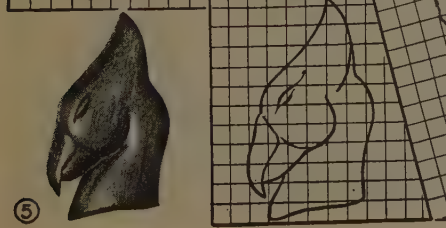
If you have a scroll saw, you can saw out as many as ten blanks of one kind at a time by stacking and bradding the layers together. In carving, mouth and eyes are outlined with clean-cut V-grooves while contours are shaped by sloping the cut to meet a vertical one. For example, the squirrel's body and tail in Fig. 1 are formed by the latter method, the eye being simply a deep V-cut accentuated with black ink.

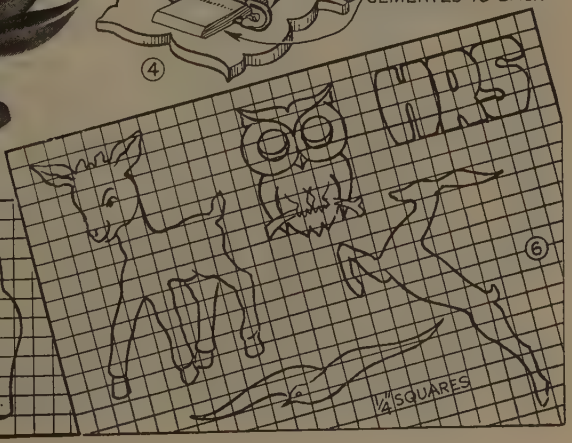
The ornaments can be sanded or left rough-carved and may be finished with several coats of hot linseed oil rubbed to a rich luster with a soft cloth, or finished with wax, shellac or varnish. Toning provides still another variation for finishing the figures. For instance, the little fawn, shown in Fig. 6, can be two-toned by staining the hoofs and nose black and the upper part of the body and legs brown.

Fig. 4 shows how a common safety pin can be attached to the back of the figures to provide a suitable clasp, or clasps made for the purpose can be purchased. Monograms, Fig. 6, and belt buckles, Fig. 3, are other examples of what can be done.

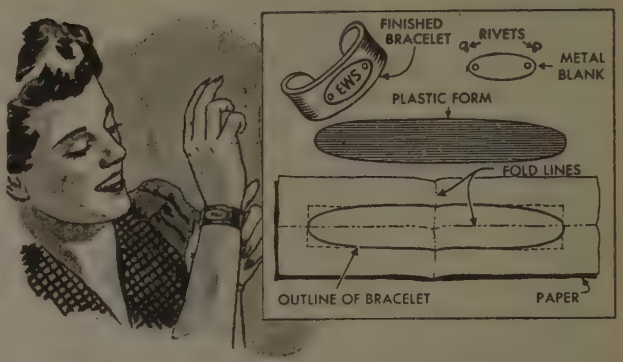








Smart Slip-On Identification Bracelet Is Made of Waste Metal and Plastic



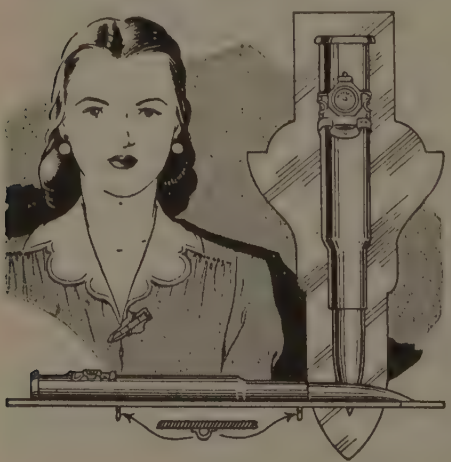
As a personalized gift, this slip-on identification bracelet is hard to beat. It's formed from odds and ends of plastic and metal that are not difficult to obtain. If the plastic you use is a dark color, select a highly polished metal, but if the plastic is light or transparent, the metal should have a dull finish.

Outline the bracelet on a piece of paper, shaping it somewhat like the sketch in the lower right-hand detail. Fold the paper horizontally and vertically and draw one quarter, transferring the line to the other quarters by pressure on the pencil. Then fill in the lines. Cut out the pattern and paste it on a sheet of ⅛-in. or 3/16-in. plastic, using rubber cement. Saw out the contour, file to the outline and finish with increasingly fine grades of sandpaper. Remove scratches by rubbing with pumice-and-oil paste. Then, buff with tripoli and rouge for a glossy finish.

Cut and smooth the metal blank to the shape indicated in the upper right-hand detail and drill 3/16-in. rivet holes in each end. You can bend the plastic by immersing it in boiling water and then forming it to shape. If necessary, repeat the heating process. Then shape the metal to conform to the curvature of the bracelet; drill rivet holes in the bracelet corresponding to those in the metal piece, using the latter as a template, and rivet in place.

Novel Brooch is Cut From Bullet

Decorative and attractive, this novel brooch is made from a .30-caliber cartridge case and bullet. The case can be either the rim or rimless type, but be sure that both powder charge and primer have been removed from the case before sawing or otherwise altering it. Don't remove either the powder charge or the primer from a "live" cartridge unless you are thoroughly familiar with this operation. Both the empty case and the bullet are sawed in half longitudinally and the rough edges are smoothed on a sheet of emery cloth laid on a flat surface. Then one half of each piece is soldered to a strip of brass filed and finished to the shape shown. If desired, the brooch can be decorated with an emblem shaped from thin brass and soldered in place. Polished surfaces should be coated with clear lacquer to prevent tarnishing. Two wire loops on the back of the brooch are for small safety pins used to attach it to the wearer's clothing.



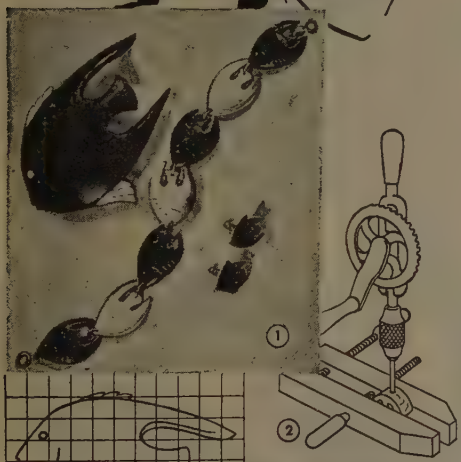
Picture Pins Are Jigsawed

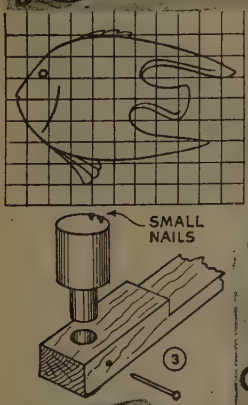
It's easy to glue an attractive picture to thin wood, saw it out and attach a clasp to the back. That's all there is to making colorful lapel pins. You can select suitable pictures from magazines or you can use photos—even one of the wearer. Plywood or hard-pressed board ⅛ in. thick is used for the back. After sawing, sand the edges carefully and then put on the clasp, which can be taken from a discarded brooch. An ordinary safety pin will do if no regular clasp is available. Strong household cement of the imitation-solder type generally will hold it in place securely. Spar varnish or transparent lacquer applied over the entire surface as a protection against moisture will add to the pin's appearance.

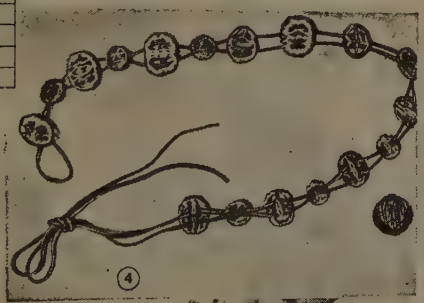
JEWELRY

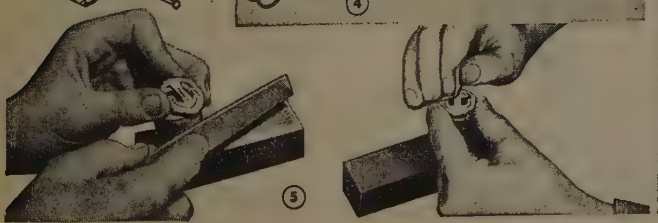
THE hobby of nutcrafting offers many new possibilities for craftsmen who like unusual novelties. Servicemen especially will find it an intriguing test of manual skill. Costume jewelry and other objects made from nutshells always are prized highly as gifts. In nutcrafting you're not limited to the hard and soft-shelled nuts alone. Plum stones, which grow in several different colors, including red, tan and brown; date stones, generally mottled in effect, and pits from cherries may be used. Shells from more than one variety often are used in working out designs for necklaces, such as shown in Figs. 6 and 9, and the bracelet in Fig. 7, as well as the belt, Fig. 4. An ensemble consisting of a lapel pin, bracelet and earrings, Fig. 1, can be made from coconut shell, which is sawed easily as in Fig. 13.

Only a few tools are needed. A small hand drill, Fig. 2, several files and a supply of fine-grit sandpaper, Fig. 5, will take care of most of the finishing operations. A special clamp, made from light flat iron and hacksaw blades as in Fig. 8, will serve to hold the nutshells in place while sawing. A coping saw with an assortment of fine-toothed blades is a necessity. The cross-hatched patterns such as that at the left of Fig. 2 and those just below Fig. 10 are included merely for the purpose of enabling you to trace the outlines and transfer these

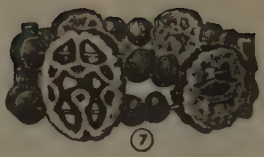








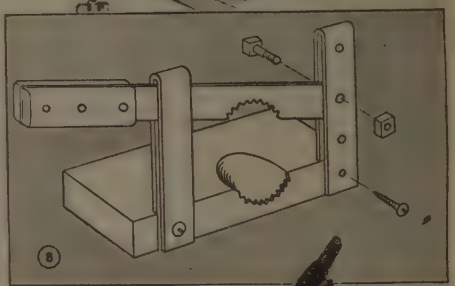
to the surface of the work. The exact size or detail will be determined by the area of the shell or whatever design suits your fancy.

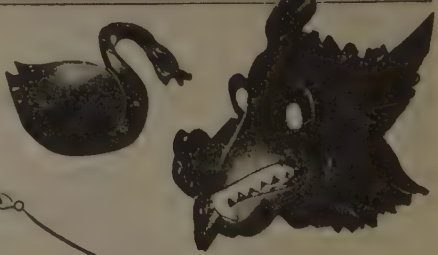


Small holes, either for stringing or for ornamentation, can be drilled through the "slices" or other parts of the shells as in Fig. 2, using a carpenter's wood clamp as shown. For stringing the finished parts of shells, use fine jewelry chain, leather thong or elastic cord.

If you use fine-toothed coping-saw blades in the slicing operations you won't have much trouble removing the saw marks from most shells. However, this must be done with care, for in nutcrafting the finish is the thing. The polished surfaces of most of the shells used in this work will take a beautiful finish even in the natural color, so it pays to do a thorough job. Producing a suitable surface on the flat-faced slices, such as those in the belt, Fig. 4, is simply a matter of persistence with file and sandpaper in successively finer grades, preferably of the "wet-or-dry" type. Sometimes the finishing operation can be speeded up by tacking a sheet of 8-0-grit paper to a flat surface such as a table top, then rubbing the slice back and forth on the abrasive. This will produce the desired smooth surface with uniform sharp edges.

Working down curved or convex surfaces can be made much easier if you take





time to make the small fixture shown in Fig. 3. By pressing the edge of the nutshell against the heads of the nails you can work on any part of the curved surface clear down to the edges with either file or abrasive paper.

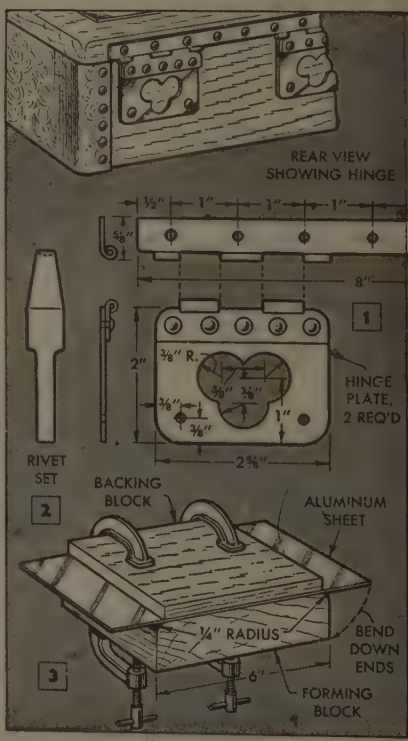
Carving nutshells is, of course, something else. However, if you have the skill and inclination, much can be done in the field of nutshell carving either by hand with a sharp pocket knife or with an electric grinder of the hand type, using wood-cutting burrs. Usually the final polishing is done with a very fine abrasive paper known as "granite" paper, and also with jeweler's rouge.

As a finishing material some nutcrafters work the oil out of the nut meats with a mortar and pestle and use this oil as a stain and polish, rubbing it on with the fingers to give the polished surfaces color and tone. Others use wax for a natural finish.

Other nutshell novelties are shown in Figs. 10, 11, 12 and 14. Those in Figs. 11 and 12 are salt shakers made from Brazil nut and English walnut shells. These are very popular items and are simple to make as the shells of both Brazil nut and English walnut work easily. In making shakers from English walnut shells care should be taken to break the halves apart without cracking. Then the inside of the shell is scraped and smoothed with a sharp knife or a wood-burring tool and the halves reassembled with a quick-setting adhesive. A single large hole is drilled in the bottom to take a cork which serves as a base. With shakers made from irregularly shaped shells such as those of the Brazil nut, it is necessary to make a base from a shell of contrasting color. Fig. 14 shows an unusual novelty display made up by using a tree limb on which are hung several nutshell baskets made from various kinds of small shells, the principal feature being a flowerpot made from a coconut. Of course, other arrangements are possible.

JEWELRY BOXES

An attractive "strongbox" dresser set of aluminum and wood safeguards jewelry and other personal items from small children



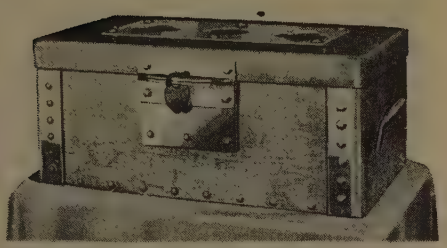
YOU GET a taste of both metal and woodworking in making these exquisite jewel boxes, and there's just enough hand work involved in making each one to test your skill in duplicating fine craftsmanship. Construction of both boxes is practically the same, the main difference being achieved by the overlay treatment. Sheet aluminum of .064 ga. is used for all the metal parts and is studded with ⅛-in. round-headed aluminum rivets.

Fig. 3 shows how the metal ends, which are identical for either box, are shaped by clamping the work between two wood blocks. Note that the forming block has the upper corners rounded to a ¼-in. radius. Cut the metal end pieces 3½ in. wide but slightly longer than necessary to permit trimming each flange to an equal width after bending. In drilling the rivet holes in the end pieces, use a jig of some kind, or a template, to align and space the holes uniformly.

Only select pieces of rare and fancy-grain wood should be used for the wooden parts of the boxes. In the case of the Queen's box, a two-tone effect can be had by making the cover of mahogany and the sides of a lighter wood, such as maple. Select a

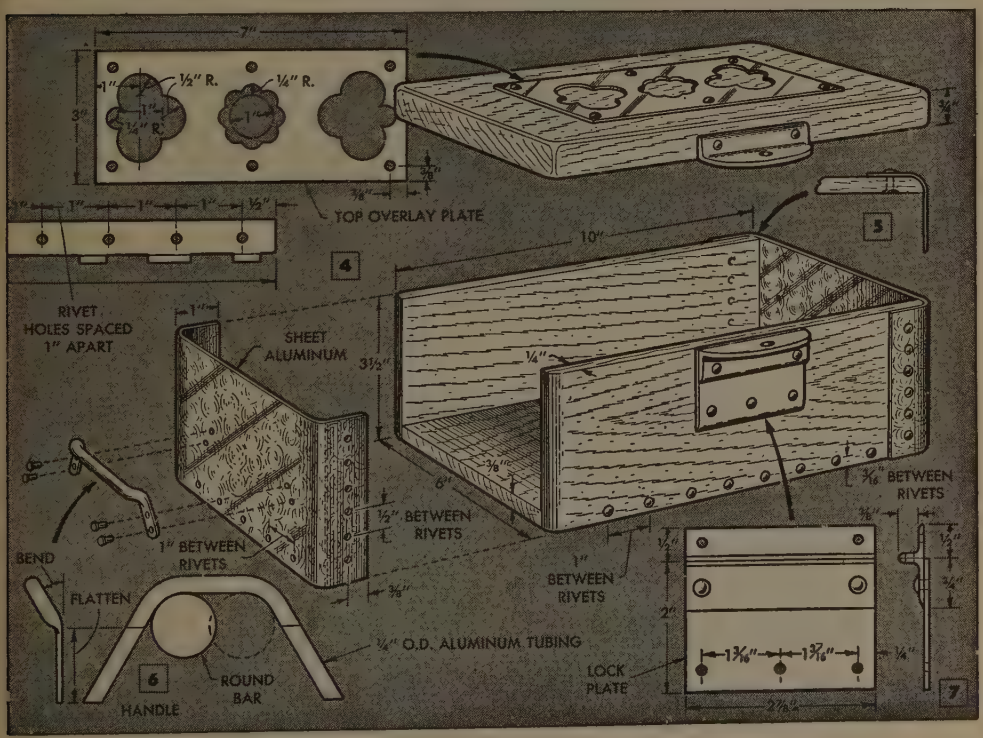
King's Box

Queen's Box



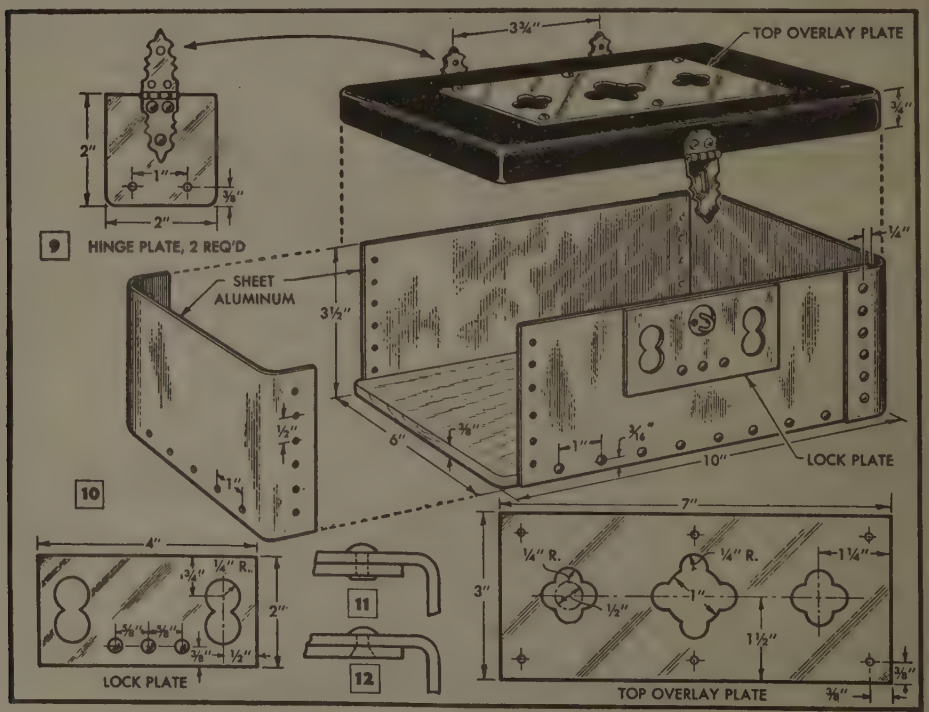
flat piece for the cover. Figs. 1 to 7 inclusive detail the Queen's box. The sides are glued to a ⅜-in.-thick bottom and then nailed to it with a nail at each corner where the nailhead will be concealed by the metal ends. The row of rivets studding the lower edges of the box are driven into slightly undersize holes which are drilled through the sides of the box and into the bottom. However, a better job of finishing the wood parts can be done before any of the rivets or other metal parts are applied.

If you have used open-grain wood, such as mahogany, walnut or oak, the pores of the wood must be filled with a prepared paste filler. This is mixed with turpentine to a consistency of heavy cream and applied in the direction of the grain, after which it is allowed to set until it begins to flatten. Then it is wiped off across the grain with a coarse cloth. If one application does not pack the pores completely, repeat the procedure. After 24 hours, sand the work lightly with 7-0 sandpaper and apply a wash coat of shellac, thinned to the proportion of shellac, 1 part, alcohol, 4 parts. This may be followed with two or three coats of rubbing varnish or lacquer, or with several applications of paste wax, whichever you may prefer.

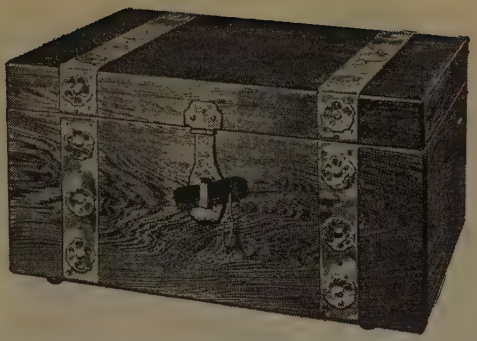


With the wood parts finished, you can rivet the metal ends to the box. Fig. 5 shows how the rivets are peened flush with the surface on the inside. For this you'll need a rivet set like the one shown in Fig. 3. It can be made from a length of ½-in. iron rod and shaped accordingly for clamping in a vise. A small depression is formed in the end to seat the rivet head. The hinge plate for the Queen's box is detailed in Fig. 1. The scrollwork in this, as well as that in the cover overlay, Fig. 4, can be cut with a circle cutter in a drill press, or with a coping saw, using a fine jeweler's blade. The part of the hinge which is riveted to the rear edge of the box cover is fastened by driving the rivets tightly into undersize holes. A piece of extruded aluminum angle is used to make the lock plate, Fig. 7, which is drilled to take a small padlock and then riveted to the box. This leaves the handles which are formed as shown in Fig. 6. The ends are flattened and bent as shown in the side view and finally riveted in place.

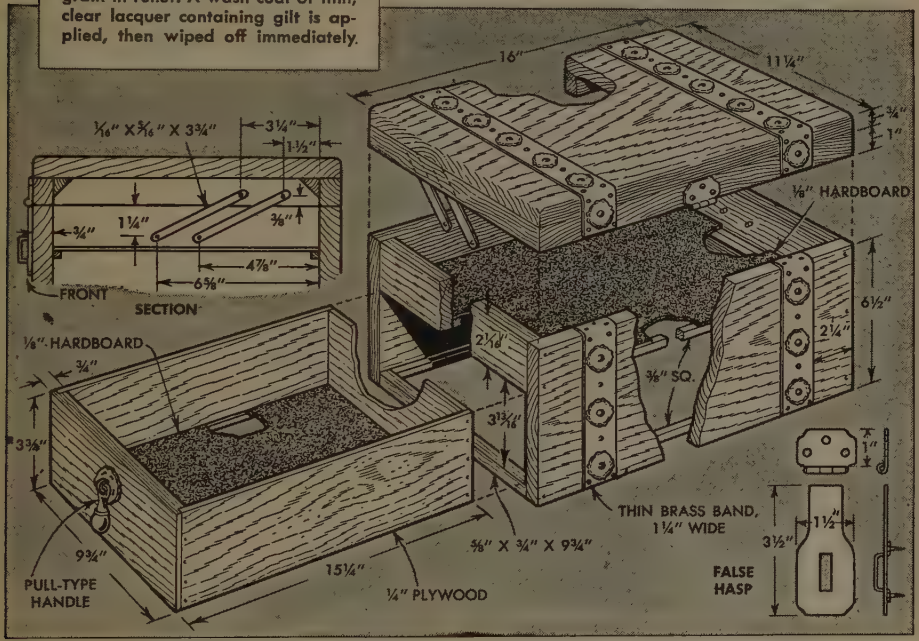
Figs. 8 to 12 inclusive detail the King's box, which is entirely of metal except for the cover and bottom. Forming the ends is done as before and these in turn are riveted to sides of metal instead of wood. Figs. 11 and 12 show two methods of peening the rivets; in one, the rivet is simply flattened against the surface, in the other it is expanded in a chamfered hole and then filed off flush. The bottom is attached by drilling undersize holes in the edge of it to take the rivets. Fig. 8 shows how the hinge plates are riveted to the back of the box and how the leaves are bent up over the edge of the cover. Adding the overlay plate and the lock plate and hasp completes the job. Cover the bottom with felt and line the inside with silk or plush.



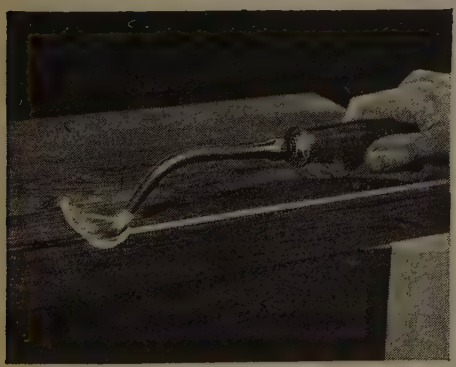
JEWELRY BOXES



The trick lid on this attractive burnt-cypress trinket chest will foil tiny prying hands for, instead of opening in the conventional manner, the lid, being pivoted on parallel arms, must be pulled forward. The sugi or burnt-wood finish is produced by charring wood lightly and rubbing with suede-shoe brush to bring out grain in relief. A wash coat of thin, clear lacquer containing gilt is applied, then wiped off immediately.

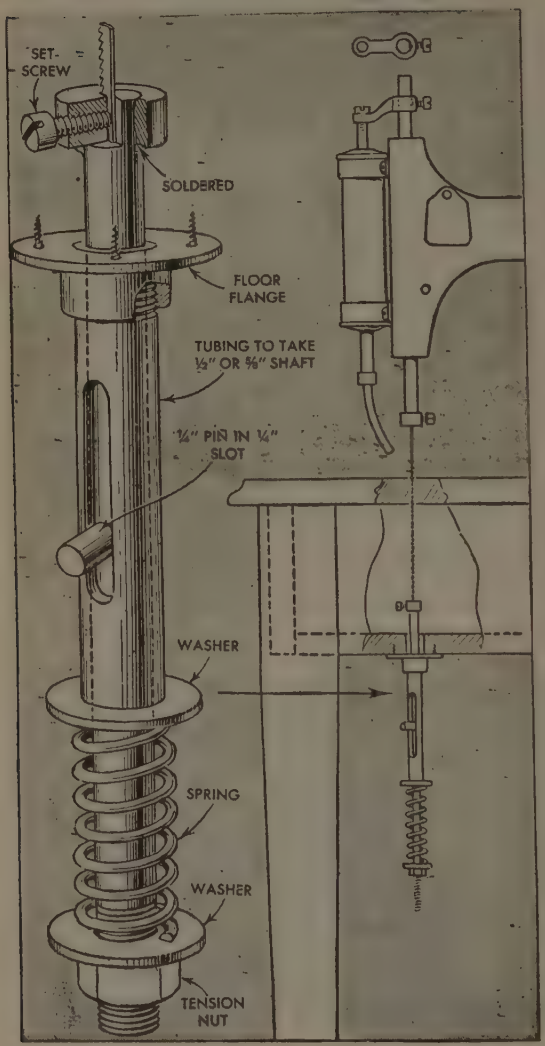


Sugi finish is produced by charring the cypress and then brushing with a fine-wire brush to raise grain



A two-piece dummy hasp parts when the lid is pulled forward and adds to the deception of how lid works

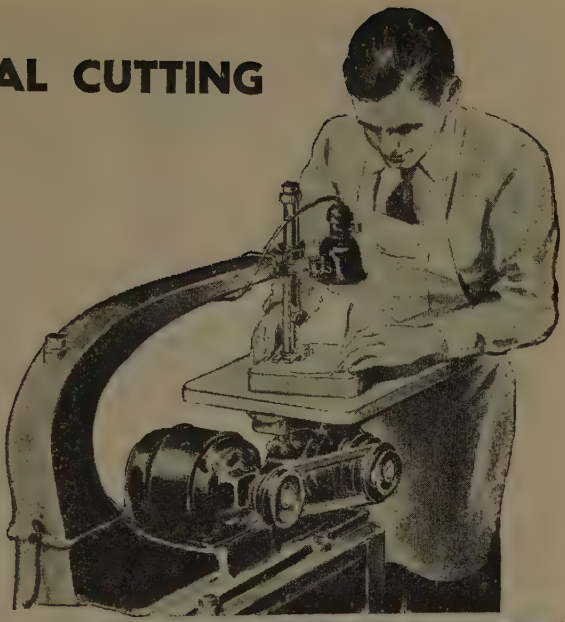
JIGSAW made from Sewing Machine



THAT old sewing machine long relegated to the attic can be converted into an excellent motor-driven jigsaw at practically no cost. All you have to do is strip the machine of its shuttle mechanism, located on the underside of the base, and install the blade-tension device shown at the left. Thickness of the stock that the saw will handle depends upon the stroke of the machine at hand, although it is possible to increase the stroke of most machines simply by raising the needle bar in the head. Drive is by a ½ or ⅓-hp. motor mounted on a hinged base to bring it in line with the pulley on the handwheel. A small insecticide sprayer, attached by brackets to the cover plate, is operated by the needle bar to provide an efficient sawdust blower.

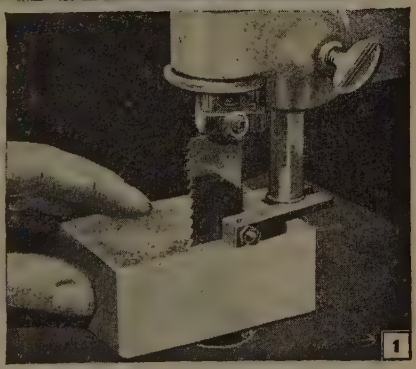
The machine can be left on its original stand, or you can set the head and base flush in the top of a sturdy bench. In either case, a board must be installed, as shown in the cutaway view, so that the tensioner can be screwed to it, directly below and in line with the needle bar. The tension device consists of a floor flange threaded to a slotted tube in which slides a spring-loaded shaft. The tension of the spring is adjusted by a nut at the end to suit the blade being used. A cross pin keeps the shaft from turning in the tube, and a collar and setscrew, soldered to the upper end of the shaft, form a blade clamp. The needle clamp will hold jeweler's blades but will require enlarging for saber-type blades.

JIGSAW METAL CUTTING

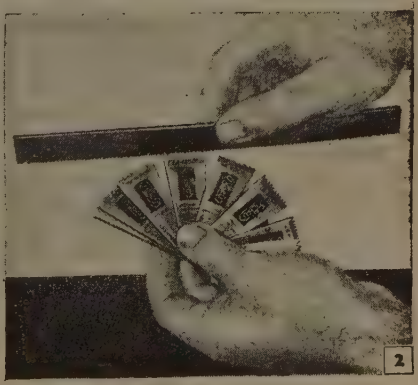


BANDSAW blades capable of cutting tough steels and other hard materials at high speeds now are available in narrow and wide widths. Cut into short lengths, they also make the best jigsaw blades available for heavy work in the hard-to-cut materials. The toothed edge of the blade is hardened by an electrical process which makes the points of the teeth almost as hard as diamonds and at the same time leaves them pin-point sharp. The balance of the blade retains all the pliability and toughness of the original steel. You can cut this portion of it with ordinary tin snips, but not the teeth. This part must be broken by bending back on itself several times. Then you grind the ends down to fit the jigsaw-blade chucks or holders and you're ready for sawing anything from wood to tough alloy steels.

The usual narrow width of ordinary jigsaw blades makes the cutting of thick wood a problem due to the blade bending and cutting on an arc. With the substantial backing of a 1-in. blade made from these new bandsaw blades, the heaviest and hardest lumber can be handled at high speed, Fig. 1. A special roller guide, Fig. 9, must be made to accommodate the wide blade. Aluminum and brass can be cut at a top speed of 1725 cutting strokes a minute. Steel goes more slowly because the teeth tend to skid instead of biting, especially at the higher speeds. With steel, a low speed and considerable pressure give best results. To get these low speeds a countershaft and step-down pulleys are used. It also is advisable to lubricate the blade with graphite grease and use cutting oil on materials requiring it.

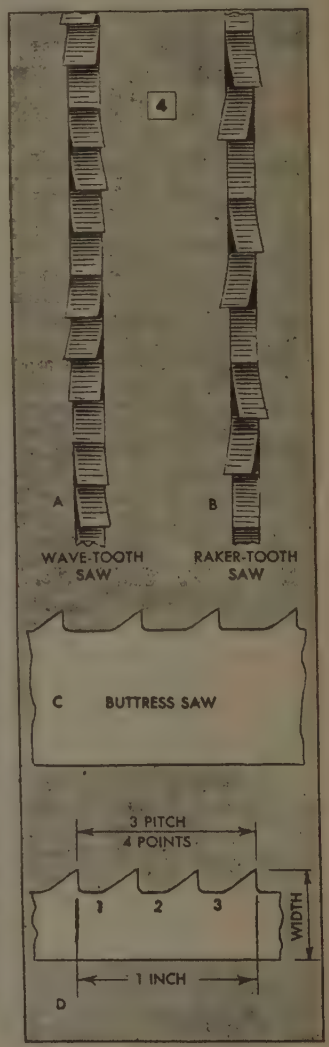


Above, wide blades work effectively in heavy cuts as they are stiffer. Below, measure the teeth with a gauge to make sure of proper blade selection



(3) GUIDE FOR PROPER SELECTION OF JIGSAW BLADES

MATERIAL	SAW PITCH Work Thickness				STROKES PER MINUTE Work Thickness			
	1/8"	1/4"	1"	More	1/8"	1/4"	1"	More
Carbon Steel	24	14	10	6	500	500	250	150
Free Machining	18	14	10	6	500	500	250	150
Chrome Vanadium	18	14	12	8	250	175	100	90
Silicon Manganese	18	14	10	6	200	100	50	
Armor Plate	18	12	10	8	175	90		
High Speed	24	14	12	8	100			
Stainless Steel 18-8	24	14	10	8	90			
Rolled Shapes	24	14	10	8	175	100	90	
Thin Wall Tubing	32	14			250	100		
Cast Iron	18	14	10	6	500	250	100	90
Aluminum	18	10	6	6	1725	1725	1300	650
Babbit-Lead	14	8	6	6	1725	1725	1725	1725
Soft Brass	18	14	8	6	1725	1300	1100	650
Phosphor Bronze	18	14	10	6	1100	650	250	90
Tobin Bronze	18	12	10	6	650	500	250	90
Copper	18	10	6	6	1300	1100	650	500
Magnesium	14	10	6	4	1725	1725	1725	1725
Monel	18	12	10	6	250	200	90	90
Nickel	14	8	6	6	200	100	90	90
Nickel Silver	18	14	10	6	650	500	250	90
Silver	24	18	14	8	650	500	250	90
Asbestos	24	14	6	4B	1725	1725	1725	1300
Bakelite	10	8	6	4B	1725	1725	1725	1725
Wall Board	14	10	6	4B	1725	1300	1100	650
Cork	10	8	6	6	1725	1725	1725	1300
Fibre	14	10	6	6	650	500	250	100
Pressed Wood	24	18	6	4B	1725	1725	1300	650
Plastics	14	10	6	4B	1725	1725	1725	1725
Porcelain	24	18			500	100		
Hard Rubber	24	18	6	4B	1725	1725	1725	1725
Transite	32	18	14	8	1300	1100	90	90
Paper	10	8	6	4B	1725	1300	1100	675
Hard Wood	18	10	6B	4B	1725	1725	1725	1725
Soft Wood	14	6	4B	3B	1725	1725	1300	1100

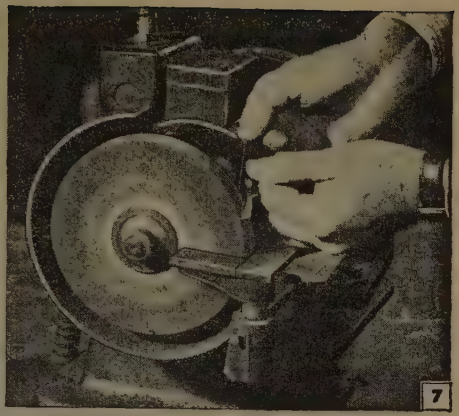


There is no such thing as an all-purpose blade, so to handle a wide range of materials a selection of blades is required. Tooth pitch and speed are of the utmost importance. The table, Fig. 3, gives a list of the materials most likely to be cut and the proper blade to do the job. Using the wrong size blade as well as running it too fast or too slow will result in poor work and short blade life. Check with a gauge, Fig. 2, and count the teeth, Fig. 4, D, to make the proper blade selection.

Although these blades sometimes are sold cut to length and ready to use, they are now readily available as mill ends. It is more economical to purchase a yard or so of blade and cut it up yourself as in Fig. 5. Grind down the ends, Fig. 7, and if the blade is too thick to enter the chuck, grind down the ends to the required thickness. Also it's generally best to grind away the teeth for 1 in. or so at each end of the blade.

Blades are commonly made with three types of teeth. The wave tooth, Fig. 4, A, comes only in 32 pitch and is used for tubing and thin sheet metal. The raker tooth, Fig. 4, B, has teeth set alternately to the right and left with one straight tooth between pairs to clear away the chip. The buttress tooth, Fig. 4, C, has every other tooth missing and is used on work where there is a tendency to clog. It is specified as 3B or 4B in the table. All types cut both wood and metal. The point to remember is to use the pitch and speed best suited for the material.

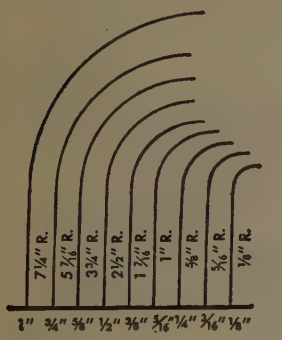
6



7

Blade life is comparatively short on the harder materials, as the upward drag tends to dull the teeth. From 6 to 12 in. in medium steel is about all you can expect from one blade. On the jigsaw a blade lasts much less time than it does on a bandsaw and cuts less rapidly. Always use the widest blade possible. This is governed by the arc of the minimum circle to be cut. The average minimum radius of various blades is shown in Fig. 8.

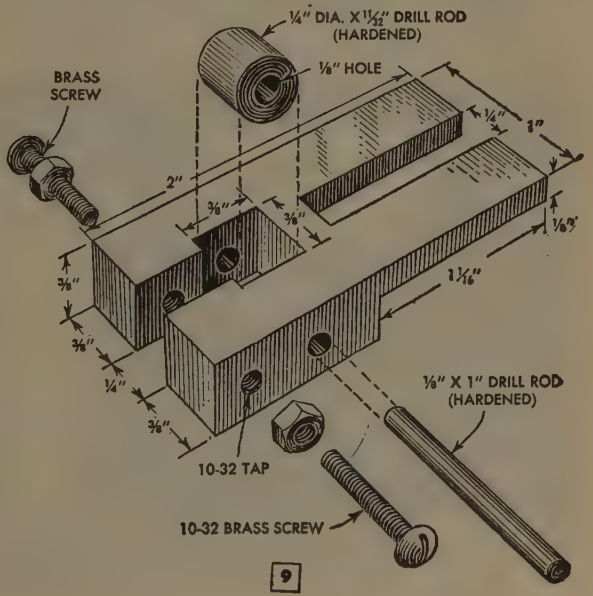
Jigsaw guides are not all alike. If your saw does not have a roller guide capable of handling the heavier blades, one should be made as in Fig. 9. Select a bar of ⅜"x1" cold-rolled steel stock and lay out a guide which will fit your saw. The type of guide detailed in Fig. 9 fits a popular model, now superseded. Other blade guides are different in minor details. Use a hacksaw to cut the body of the guide to the required shape, then finish by filing. It is advisable to leave a considerable "handle" on the stock, so that you can hold it easily in the vise. Saw off the handle when no longer needed. Drill holes before making cuts, to assure alignment. Harden the shaft and roller of the guide after fitting. The two guide screws are adjusted each time a blade is changed and any wear can be taken up quickly.



SAW WIDTH
FOR 1" WORK THICKNESS
ALWAYS USE THE WIDEST
SAW POSSIBLE

8

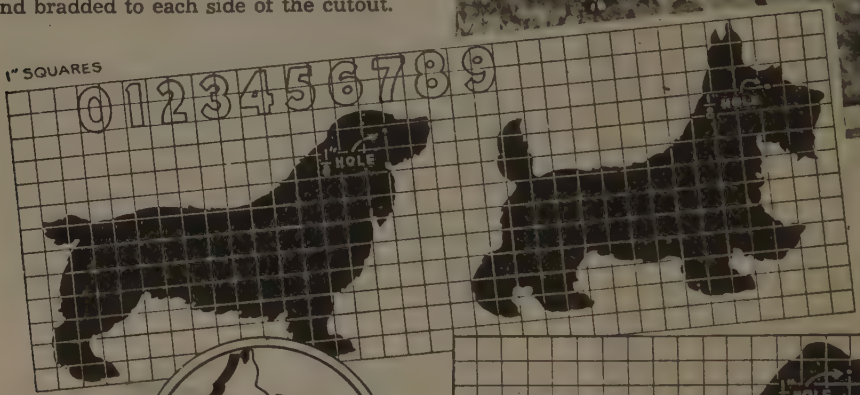
Above you have charted approximately full size the average minimum radius cuts for blades of various widths. When turning a radius in either wood or metal, the trick in getting a smooth-edged cut is to keep the blade cutting uniformly while in the curve. If you stop the work or move it irregularly you will get "flats" along the sawed edge

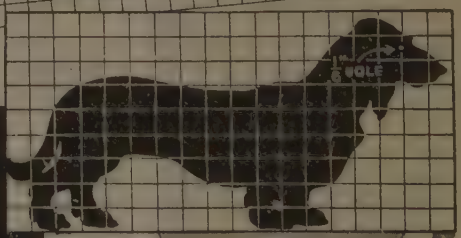


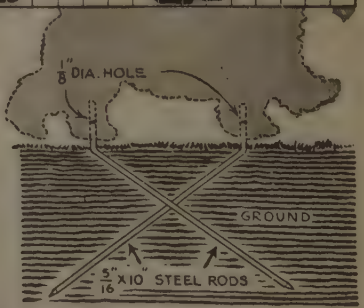
9

JIGSAW PROJECTS

SET in a parkway, on your lawn or at the curb, the Scottie-dog cutout at the right, with its sparkling eyes, jauntily poses your house number in plain view. The cutout can be sawed to represent any animal or pet if those given below do not suit. Cut it from 1⅛-in. selected white pine and paint in appropriate colors. Reflector-type bolts used for car licenses serve as eyes and reflect the light from passing cars. The numbers are sawed from ¼-in. white pine and bradded to each side of the cutout.

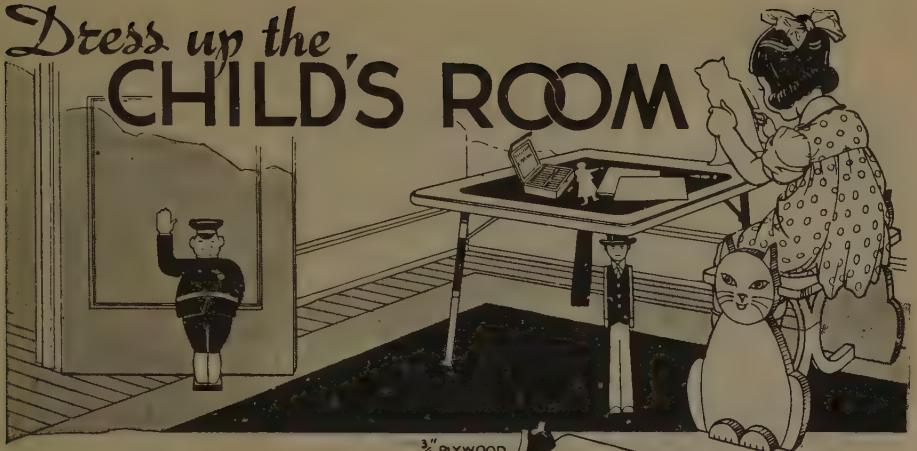




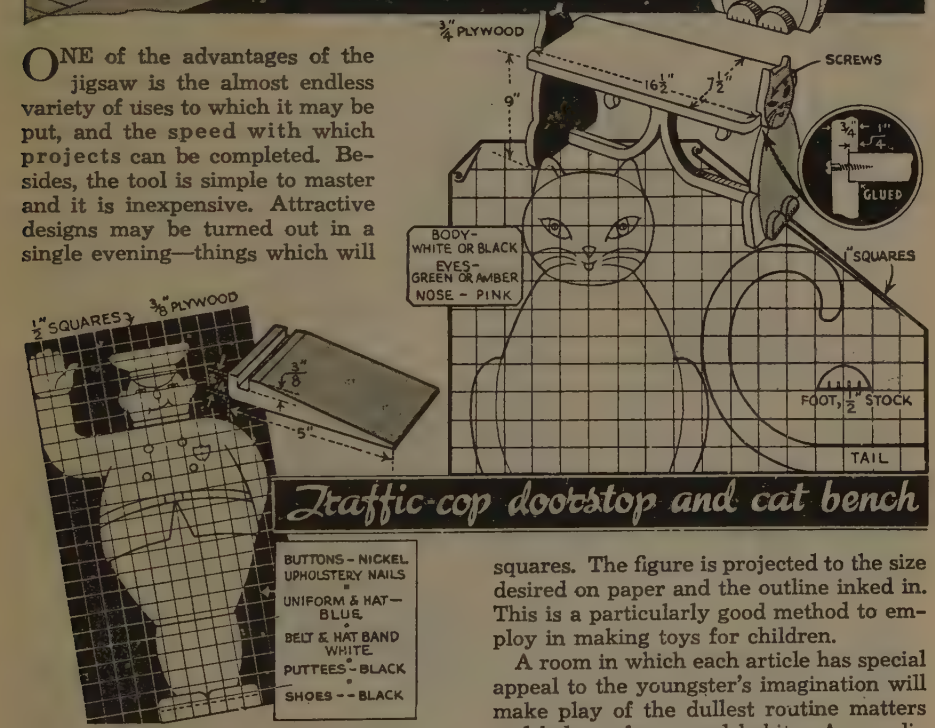


There is little possibility of theft if you mount the cutout on rods driven deeply into the ground as above. Drive screws into the side of the feet to fit into holes near the rod ends and then file the heads so that they cannot be removed with a screwdriver

Dress up the CHILD'S ROOM



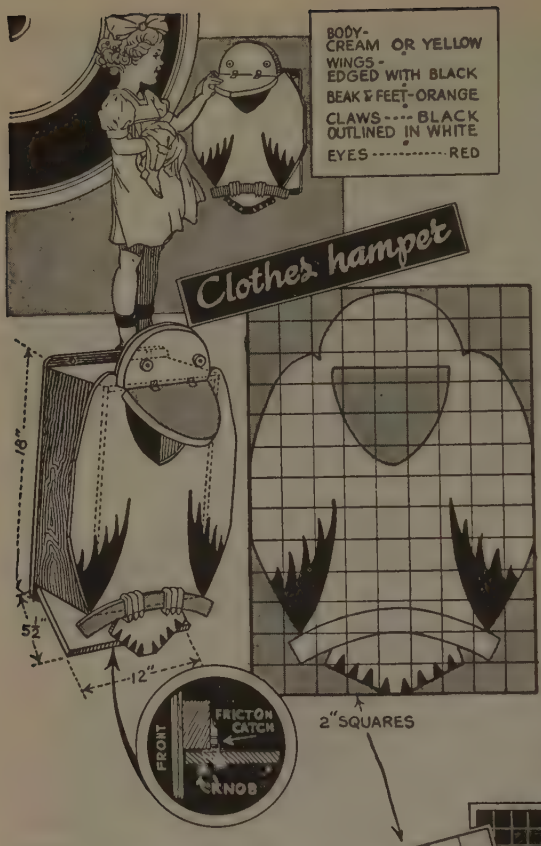
ONE of the advantages of the jigsaw is the almost endless variety of uses to which it may be put, and the speed with which projects can be completed. Besides, the tool is simple to master and it is inexpensive. Attractive designs may be turned out in a single evening—things which will please your family and arouse the admiration of your friends. And then you can create your own projects, or reproduce quickly the novelties you see in stores or windows, varying the designs to suit yourself. Many craftsmen are using a photographic projector to vary the size and enlarge the outlines of figures and pictures on which they desire to work. An old magic lantern will serve the same purpose, thus avoiding the work of enlarging the squares. The figure is projected to the size desired on paper and the outline inked in. This is a particularly good method to employ in making toys for children.

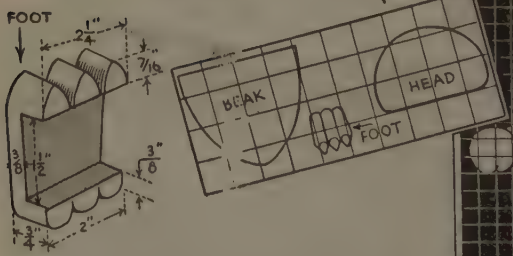


Traffic-cop doorstop and cat bench

A room in which each article has special appeal to the youngster's imagination will make play of the dullest routine matters and help to form good habits. Any ordinary room can be dressed up to please your child, with only the aid of a jigsaw and a few hand tools. All of the articles shown here are of simple construction, just the kind of work for spare time, and scraps can be utilized in making some of them.

The traffic-cop doorstop is scroll sawed from ⅜ or ½ in. plywood and has a wedge-shaped base. It is grooved for the feet, which are glued and nailed in place. Buttons on the cop's coat are small upholstery



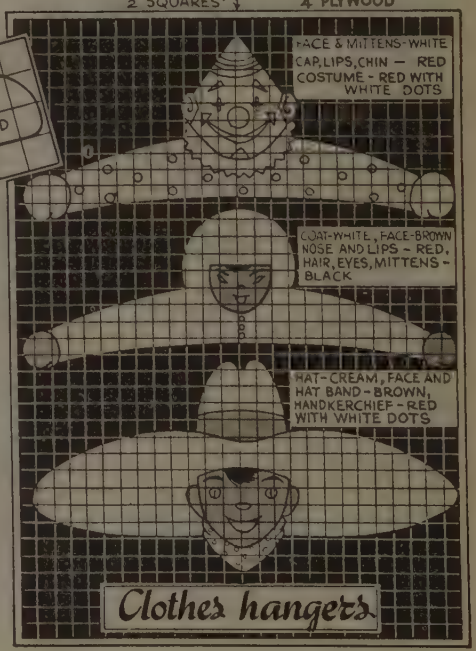


nails. The top of the cat bench fits into grooves in the sides, and screws are driven through the eyes into it. Round the corners of the top to meet the ends. The tails are attached with screws, which are countersunk, while the feet are glued and nailed on.

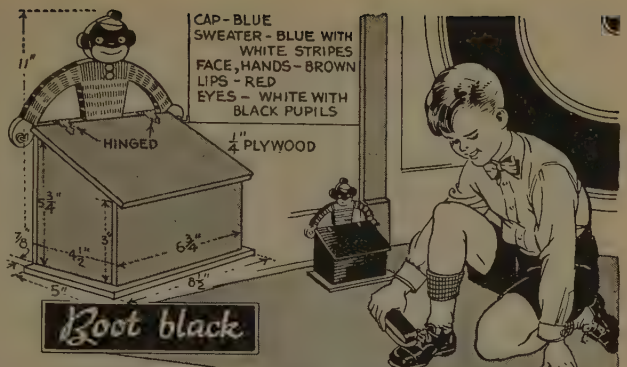
Putting soiled clothes into the bird-front hamper on the wall or door is a delight to any youngster. The hinged beak covers the opening and the bottom is hinged for removal of the clothes. Saw the bird from ¼-in., the limb from ⅜-in., and the head, beak and feet from ¾-in. stock. Cut disks ¼ in. thick for eyes. Nail a strip of wood to the back of the bird, even with the bottom of the box, to serve as a stop for the bottom, which is held in place by a friction catch.

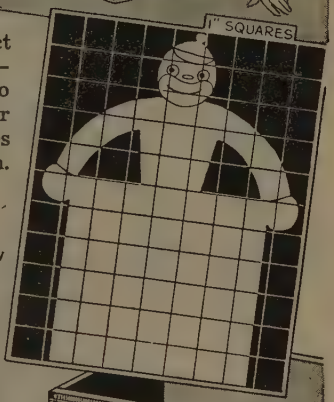
Clothes hangers with personality will help to get a child into the habit of hanging up clothes. Saw the hangers from ¼ or ⅜-in. plywood, round the edges and sand them smooth. Use wire hooks from ordinary hangers, the kind having straight stems. Bend the end of the wire slightly, apply a coat of household cement and force it into a hole bored vertically in the top of the hanger. When making the clown hanger, bore the hole for the hanger before the pointed cap is cut. The Eskimo is particularly suitable for a youngster's winter togs, while the cowboy's "five-gallon" hat is just the thing for sport clothes. The clown's foolish grin and his fantastically painted face make him a favorite.

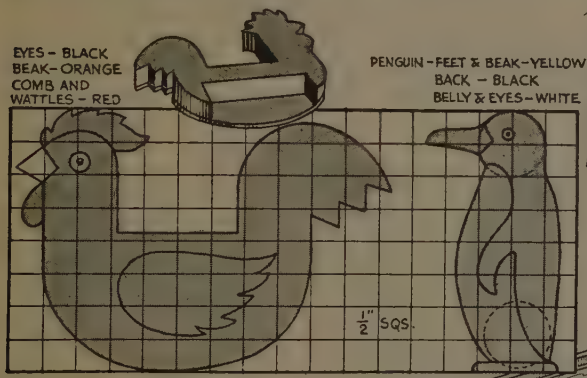
Any child will take pride in keeping shoes shined with a grin-

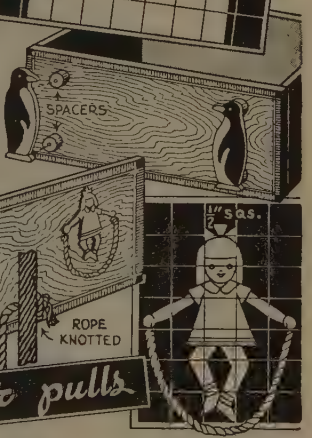


ning bootblack always ready to help. A little black box with the hinged top holds polishes and the darky's hands are provided with hooks to hold a shiner, buttonhook and shoehorn. Build the bootblack and box from ¼-in. plywood, sawing the back of the box and the figure in one piece. The base should extend beyond the sides and front of box and a notch is cut out for the back to fit in. Fasten the pieces together and saw out a lid which also will project a little over the sides and front. Black is the most practical color for the box, as it is just the right height to support the foot while shining the shoe. A vivid sweater and cap offer contrast to the black face and box. The eyes are white thumbtacks with black spots painted on them.



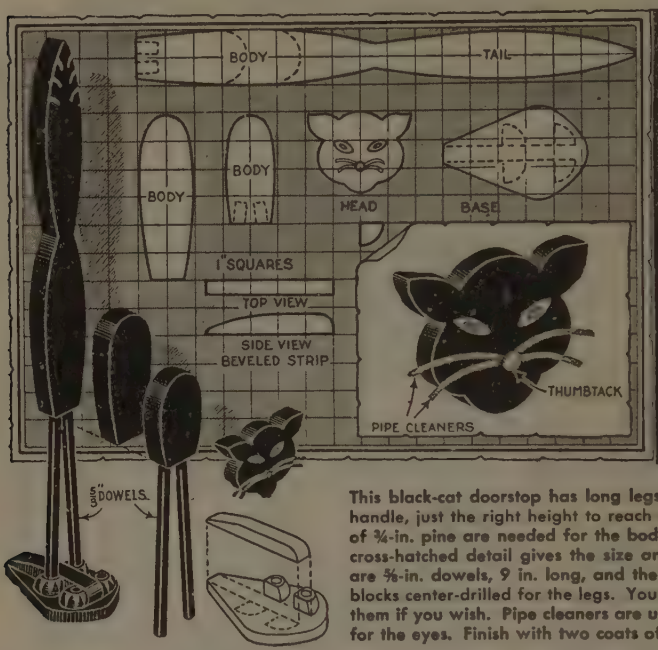






Chests of drawers, dressers or cupboards are easily adapted to juvenile use by giving them a new coat of paint and colorful handles such as gaily painted cocks, sleek penguins or jumping-rope girls. These may be placed in pairs, face to face, or in single file down the center of the drawers. All of these will delight the child and are made in a jiffy. Use ¼-in. plywood for the front of the cock and ¾-in. stock for the back, part of which is cut away to leave space for the hand. Glue the two pieces together and put in small screws at both ends to hold them more securely, countersinking them and filling the holes with putty or other plastic filler. Saw the penguins from ⅜-in. plywood. Glue and screw ¾-in. lengths of 1-in. dowel under each end to hold them away from the drawer to accommodate the hand. A small upholstery tack or a flat bead held on with a brad makes a good eye. The jumping-rope girls are cut from ¼-in. plywood, painted in gay colors and glued to the drawer. Lightweight, twisted clothesline is used for the jumping rope. Bore holes in the drawers behind the hands, draw the two ends of the rope through and tie knots on the inside to secure them.

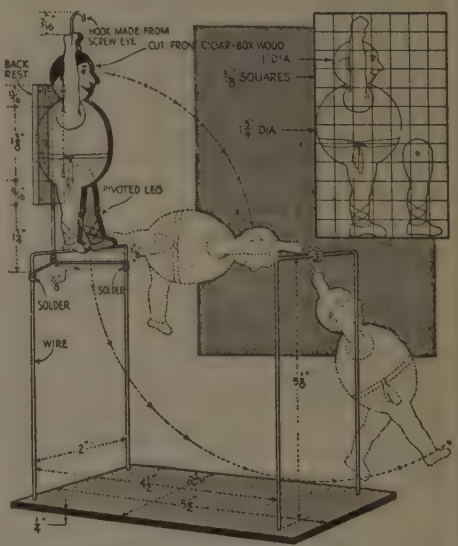
"Cat" Doorstop Reached Without Stooping



This black-cat doorstop has long legs and its tail provides a good handle, just the right height to reach without stooping. Four pieces of ¾-in. pine are needed for the body and the head and tail. The cross-hatched detail gives the size and shape of these parts. Legs are ⅝-in. dowels, 9 in. long, and the feet are simply quarter-circle blocks center-drilled for the legs. You can leave them plain or carve them if you wish. Pipe cleaners are used for whiskers, cloth stickers for the eyes. Finish with two coats of good quality flat black paint

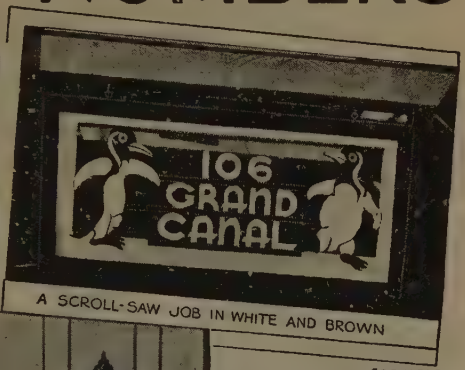
This Tumbling-Acrobat Toy Will Delight Small Children

Here's a simple toy that will give the children a lot of fun. When the acrobat is knocked over, it appears to be falling to the floor. But just at the crucial moment, it hooks onto the next bar and swings with ease. A slotted back rest keeps the acrobat in position for the next act. The figure is cut out of cigar-box wood with the arm and the right leg in one piece. The left leg is cut separately and swings on a pivot to give movement. A couple of pencil lines will establish identity of the arms and both sides.

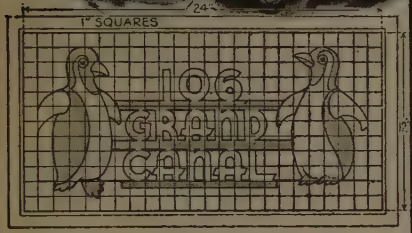


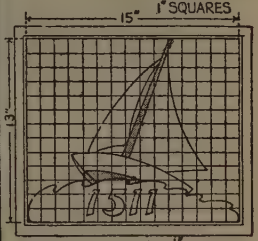
Dropping from a vertical position on one bar, the acrobat grabs the second bar as he falls and swings safely in a realistic manner

New HOUSE NUMBERS

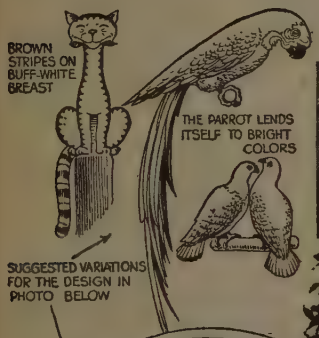


A SCROLL-SAW JOB IN WHITE AND BROWN

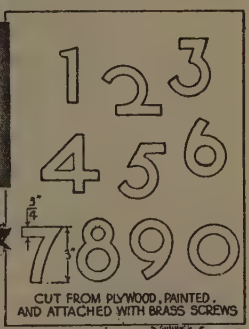




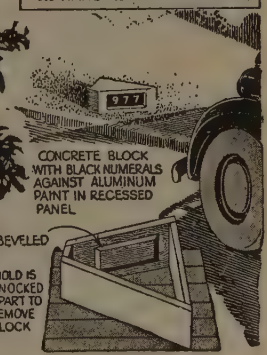
SCROLL-SAWED FROM $\frac{1}{4}$" PLYWOOD



SUGGESTED VARIATIONS FOR THE DESIGN IN PHOTO BELOW



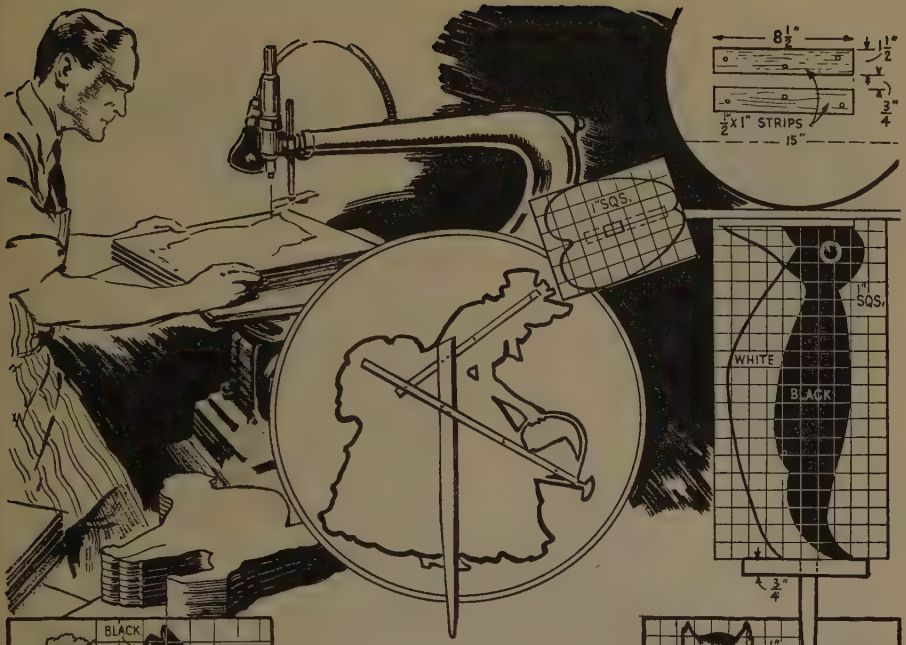
SPELLED-OUT NUMBERS ARE ATTRACTIVE


9771
CONCRETE BLOCK WITH BLACK NUMERALS AGAINST ALUMINUM PAINT IN RECESSED PANEL
BEVELED
MOLD IS KNOCKED APART TO REMOVE BLOCK

Jig-Sawed LAWN ORNAMENTS

MAKING things with a jigsaw is not only a fascinating hobby, but also a good way to turn your spare time into profits, as the experience of thousands of persons all over the country proves. While it is true that it is impossible for the craftsman to compete with mass production methods on a price basis, there still is a place, and a quick sale, for attractive novelties which it would not pay a big factory to touch. Often such articles can be sold to friends and neighbors, or orders may be taken from samples from department stores, gift shops and specialty dealers. In such cases the price asked should be at least double the cost of production. Lawn ornaments, house numbers, door stops, necktie holders and bird houses are all in demand. Orders also may be taken for toys, in the design of which the craftsman can exercise his ingenuity and skill.

Arranged in an effective display around any roadside stand, these colorful lawn ornaments will attract passing motorists and bring in a substantial revenue. One class of figures, primarily for use on the lawn, includes the alert bulldog and the warning policeman to replace the usual "Keep-Off-the-Grass" signs. The sprinkling maid is a popular item as well as the miniature fireman who can hold the nozzle of a garden hose. Another class of ornaments are those like the climbing squirrel, the hanging monkey and the woodpecker, to be used on trees, while a black cat makes a novel silhouette on the ridge of a garage roof, and a taciturn owl watches doings in the garden from a fence post. For those who like small lawn tables to hold books, cigarettes or even for serving tea, the penguin stand has a pointed stake which is



pushed into the ground. Use ¼-in. stock. Plywood is good material if the edges are thoroughly filled with white-lead paste before finishing, to prevent water absorption. Hard-pressed fiber board may also be adaptable. You can cut out several duplicate figures at the same time by stacking the stock. Where designs have slender parts, likely to break off, use reinforcing strips on the back.

In finishing, apply a base coat of white and over this the finish coat of colors. If you have a paint-spray gun, similar figures can be uniformly finished and decorated in record time by the use of sheet-metal masks to block off portions of the background in colors other than the one you are applying. Some of the figures, of course, will require the use of a striping brush to outline various features.

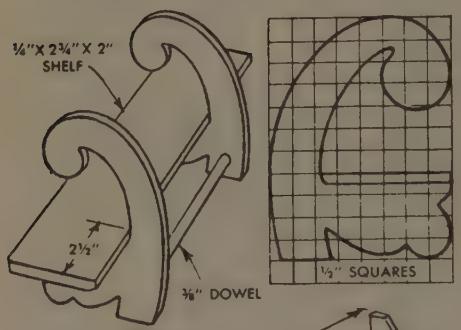
JIGSAW PROJECTS

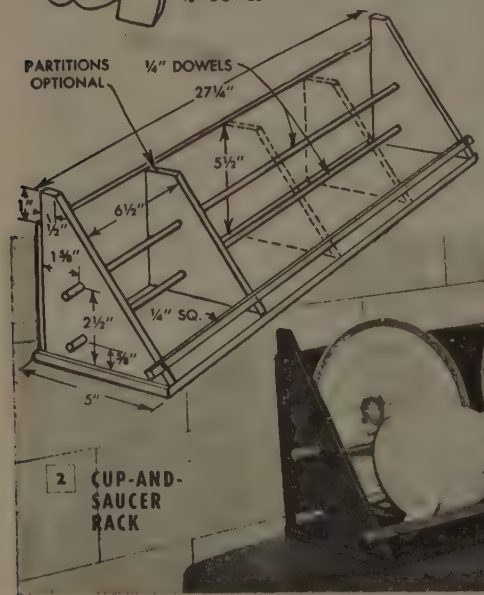
1 TOWEL RACK

THERE'S EXTRA money in the basement workshop, and these eight attractive projects are just the thing to turn a woodworking hobby into real profit. By making samples of each item and taking them to local gift shops and variety stores, you will find most of the dealers glad to handle part, if not all, of the line. The simplicity of construction and design of these projects not only lends itself to mass production, but also makes them ideal for woodworking classes as well as individual one-evening projects for the home craftsman.

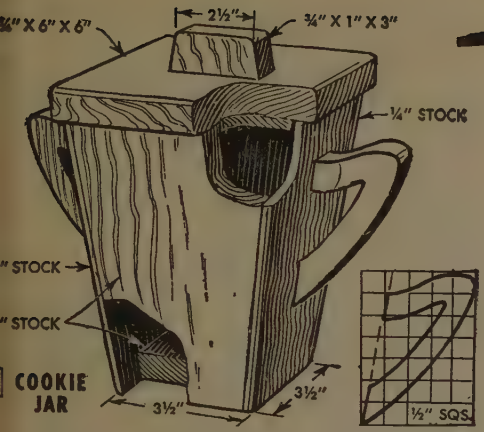
Although a coping saw will handle the scrolled designs, quantity production of the novelties requires the use of a jigsaw or a bandsaw. Templates of hardboard or heavy cardboard should be made for the various parts as this will eliminate the need for laying out the pieces each time a project is made. Multiple cutting of duplicate parts wherever possible will speed the work.

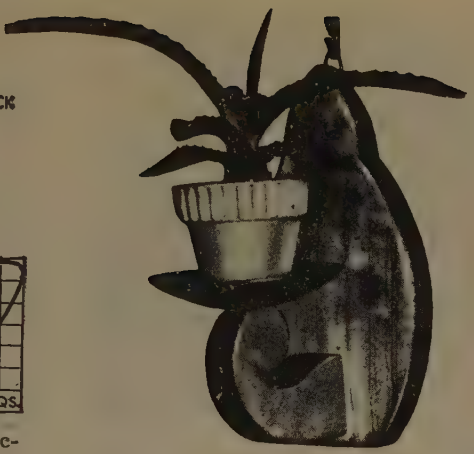
The stock used in most of the original projects was salvaged from orange crates and apple boxes, utilizing both the thin side and bottom slats along with the heavier endpieces. After the parts are cut out, the wood is sanded thoroughly with fairly coarse paper. Then, when the joints have been glued and nailed, and the corners rounded, the entire project is sanded with a fine-grit paper. The wood may be finished by





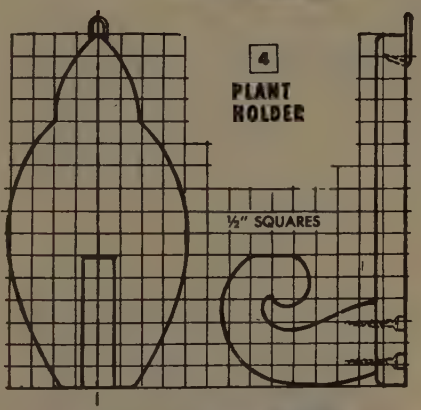
2 CUP-AND-SAUCER RACK

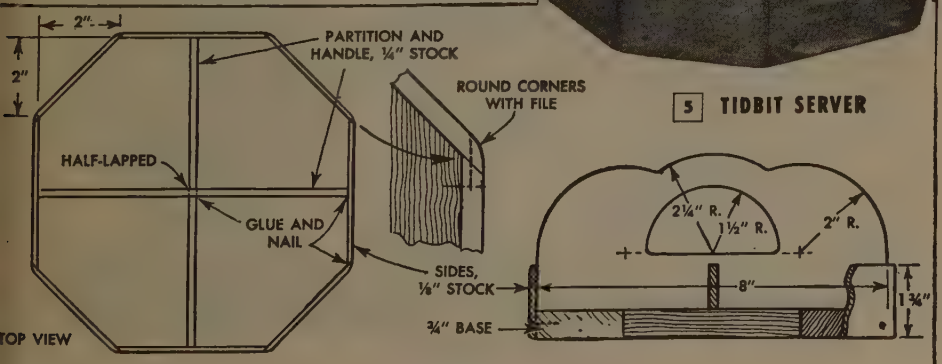




staining or enameling, an especially attractive finish being applied to the crating by coating it with a maple oil stain. The depth of color is controlled by the length of time the stain is allowed to remain on the surface before it is wiped off. The stain is followed with a coat of clear shellac which is rubbed with fine steel wool after it dries. Finally, a coat of paste wax is applied over the shellac.

The flowerpot holder and the dinner gong incorporate inexpensive stamped-metal ash trays which can be purchased in sets. In the projects shown in the photographs, ¾-in. hard maple was used for the wall bracket of the flowerpot holder and the Chinese-styled frame of the dinner gong. The maple may be stained or given a natural oil finish. To apply the latter, sand the surface, coat with hot linseed oil or sweet oil and then rub in the oil with a felt pad. The ash-tray support for the flowerpot is drilled and screwed to a flat which is cut on the top of the scrolled bracket. A rubber washer is inserted under the head of the screw to prevent any water leakage from seeping through the hole in the ash tray.

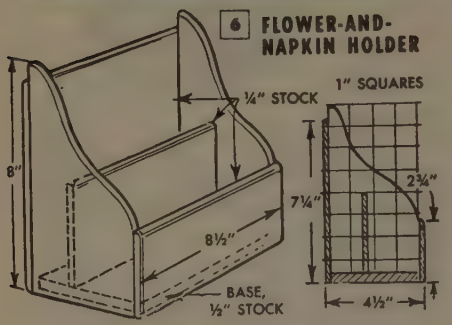


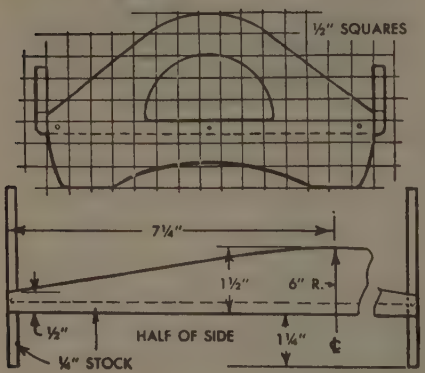


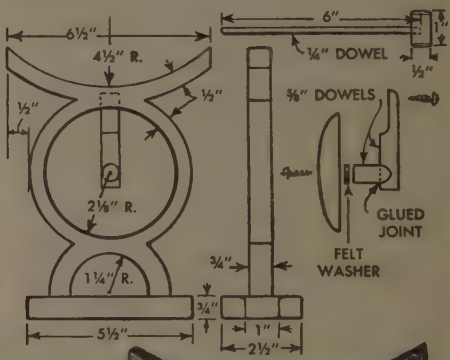
The towel rack, plant holder and flower-and-napkin holder all can be hung from the wall by drilling surfaces that come in contact with the wall and driving brads in the wall at corresponding points. The wood should be drilled to receive the brads at a slight upward angle. The wall pieces may be hung by an alternate method using a picture hook and staple. The staple is driven into the wood and bent upward to engage the picture hook, as shown in the photo of the flowerpot holder.

When making the cookie jar, fasten the handles to two sides with glue and screws before assembling the jar. The wooden jar will be easier to keep clean when in use if it is lined with pieces of cardboard wrapped in wax paper. Cut the cardboard liner sections so they will drop from the jar when it is turned upside down, but still fit snugly enough to retain the cookie crumbs.

Artificial flowers are used in the front section of the flower-and-napkin holder, the stems being inserted in sand or a frog made from a piece of wire mesh. However, if lined with sheet metal, the front of the holder will also serve as an attractive ivy planter. ★ ★ ★

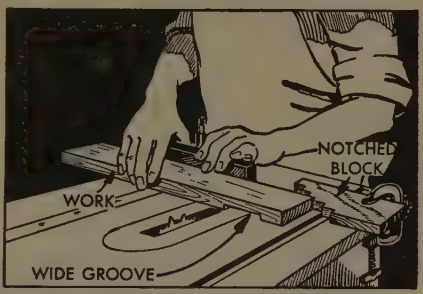


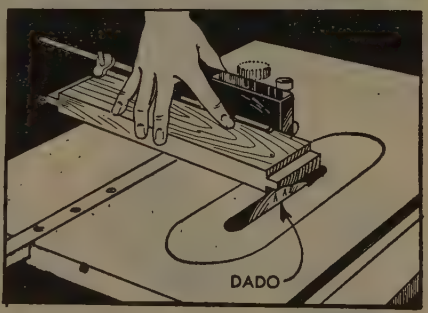


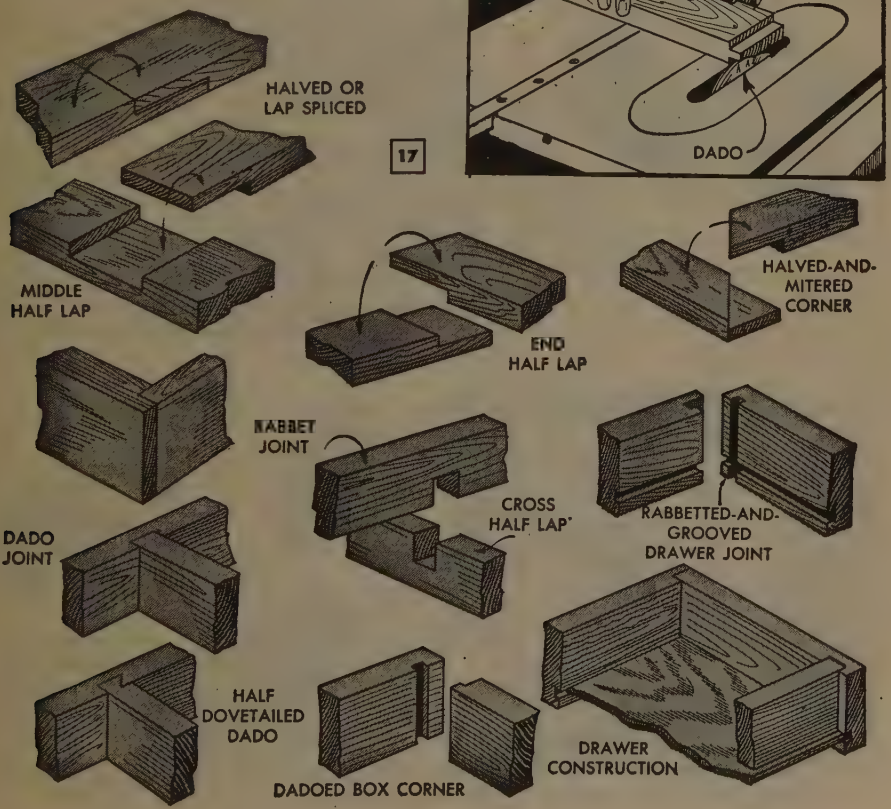


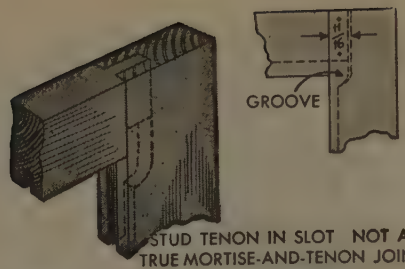
JOINT MAKING

EACH OF THE JOINTS detailed below can be completed on the circular saw. All of them are used in cabinet work. When you study detailed drawings of interior woodwork, kitchen cabinets, linen closets and other similar types of work you will see types of these joints often, both in the framing of the cabinet and in drawer construction. If you are not already acquainted with the use of the dado head the sketches at the right give you the first hint of the versatility of this circular-saw accessory. The upper detail shows a method of making adjacent cuts to form a groove of exact width. You'd use this method to form a groove of the required width for the half lap, lap splice, or the middle half-lap joints. The notched block clamped to the saw table stops each individual cut. By simply moving the stock to a new notch after each pass of the work over the cutters you get a wide groove of the exact width required. In the lower detail the dado is set up to make the cheek cut on a tenon, and here the miter-gauge rod is used to assure accuracy. The trick is to make sure that the cutters are set at the correct height above the table so that you get a tenon of just

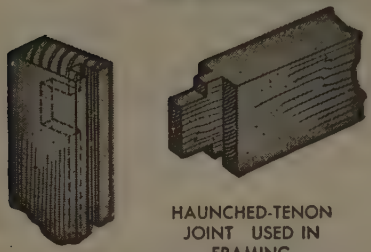




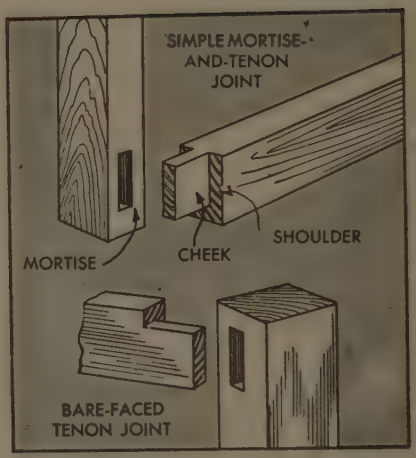




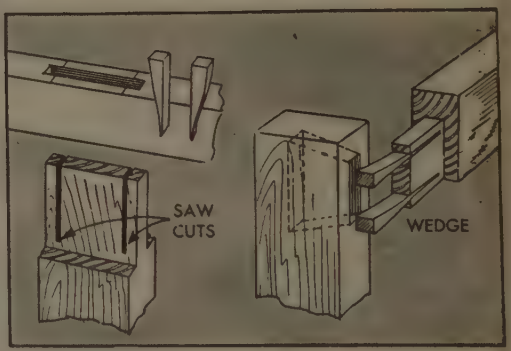
STUD TENON IN SLOT NOT A TRUE MORTISE-AND-TENON JOINT

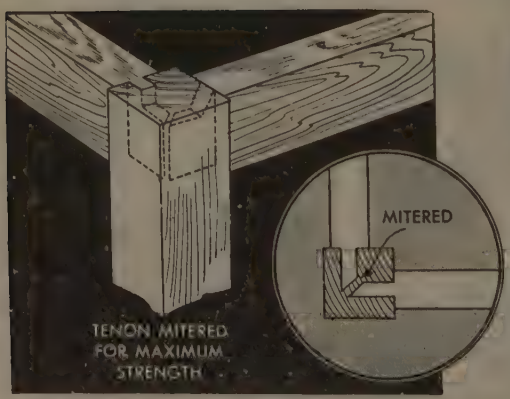


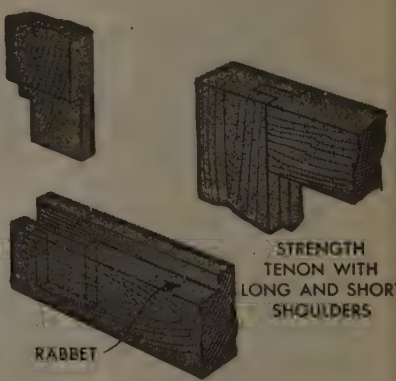
HAUNCHED-TENON JOINT USED IN FRAMING



HAUNCHED TENON JOINT DOES NOT SHOW BREAK IN END OF STOCK

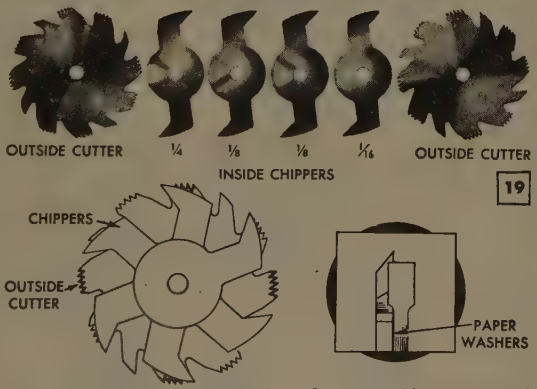






Here's a dado head cutting a wide, deep groove in a piece of 2 x 6-in. stock. In cabinet joinery, which is just another name for making joints of various types, the dado head is an indispensable power-saw accessory. When properly sharpened and mounted on the arbor, it is capable of extremely accurate work

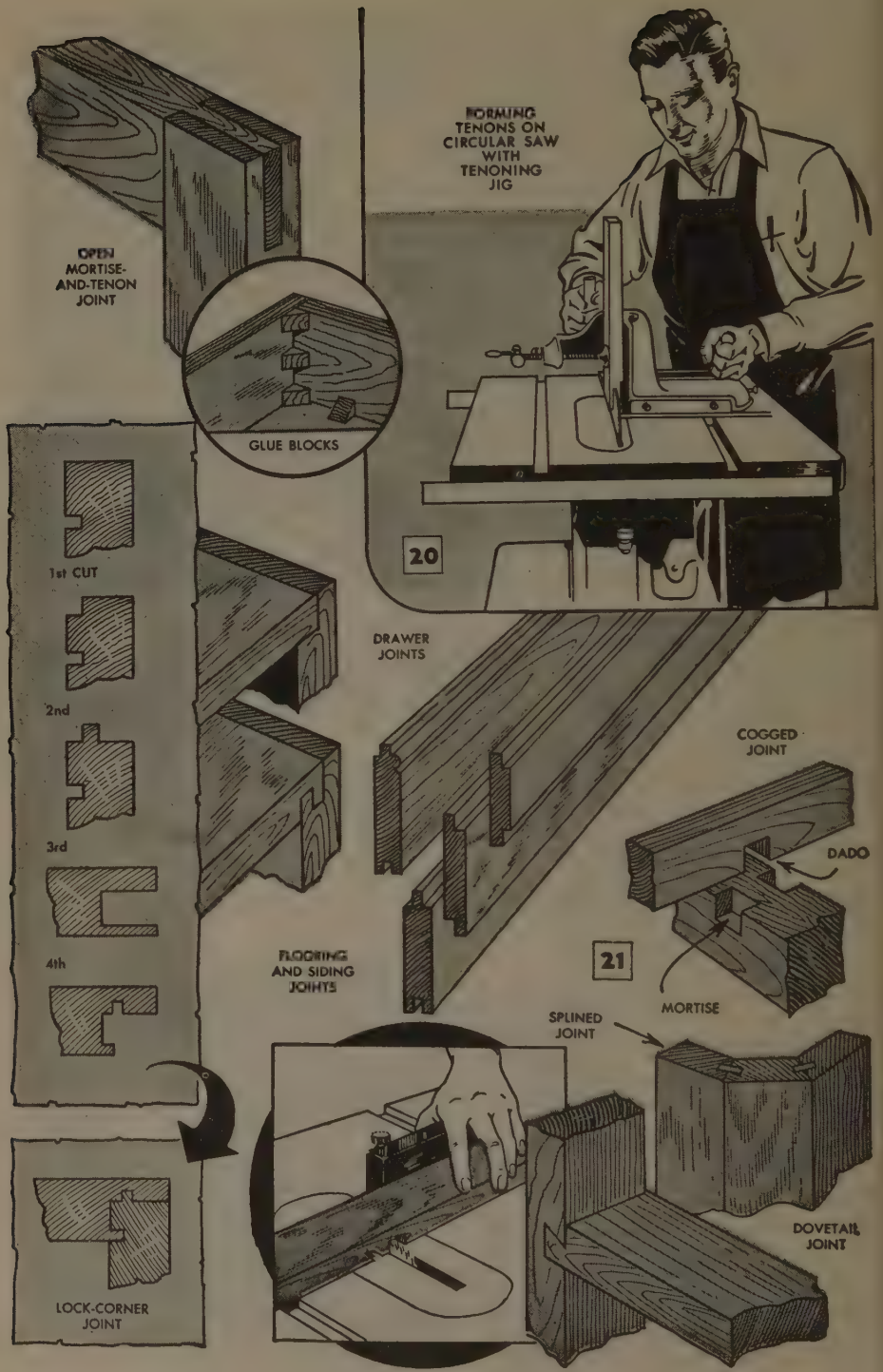
the right thickness. Once you are sure of the setup you can run a hundred tenons and all of them will be precisely alike. In the detail at the right you see the various cutters which assemble on the saw arbor to form what is known to the woodworking trade as the dado head, or cutter. In the photo above you see it working, cutting a wide, deep groove in heavy stock. The two outside cutters are each ⅛ in. thick and are toothed just like a combination circular saw blade. The inside units have only two cutting edges and operate as cleaner teeth. Two of the inside cutters also are ⅛ in. wide, a third is ¼ in. wide and a fourth is 1/16 in. wide. Thus you can see that, beginning with a single outside cutter, you can cut grooves varying in width by 16ths from ⅛ in. to 13/16 in. This grooving range covers practically all ordinary cabinet work where grooves or rabbets are required in the joinery. Wider grooves, from 13/16 in. up, are formed simply by running adjacent cuts from a notched stop block as previously described.

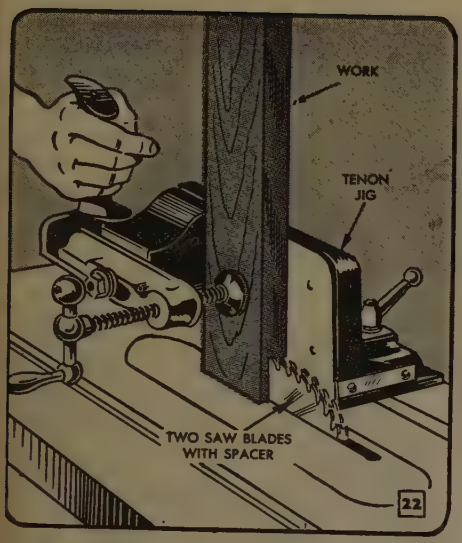


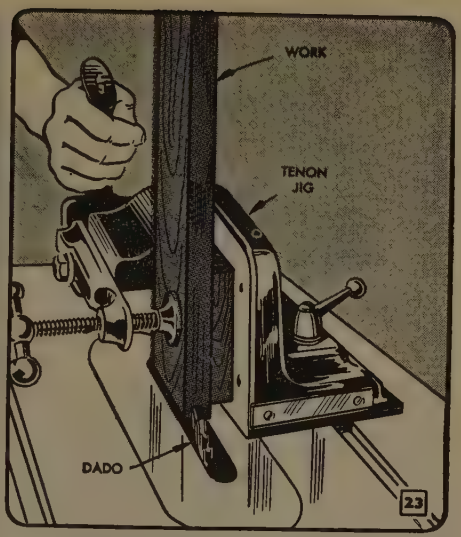
The ordinary dado head consists of two outside cutters and four inside chippers which are assembled on the saw arbor in combinations that cut different widths from 1/8 to 13/16 in.

Mortise-and-tenon joints detailed on the opposite page bring up the first instance of the limitations of the small homeshop equipment. All the tenons shown on the various joints can be run with the dado head but only one of the joints can be made complete. That's the one in the upper left-hand corner, and this is not a true mortise-and-tenon joint because the mortise is really a slot. All the others are true mortises, that is, they are closed at both ends. None of the closed mortises can be made on the circular saw with the regular accessories. However, the square-end mortises are easily made with a drill-press accessory.

A tenoning jig which is supplied as an accessory for the circular saw is shown in three details in Figs. 20, 22 and 23. The jig is guided by a spline which fits in the miter-gauge groove and is adjustable horizontally to accommodate stock of varying thickness. Note in the detail of Fig. 22 that two saw


FORMING TENONS ON CIRCULAR SAW WITH TENONING JIG
OPEN MORTISE-AND-TENON JOINT
GLUE BLOCKS
20
1st CUT
2nd
3rd
4th
DRAWER JOINTS
COGGED JOINT
DADO
21
MORTISE
FLOORING AND SIDING JOINTS
SPLINED JOINT
DOVETAIL JOINT
LOCK-CORNER JOINT

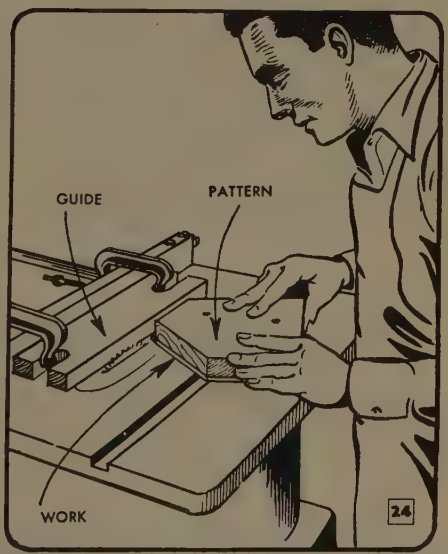




On the opposite page and also in the two views above a tenoning jig is shown in operation. This circular-saw accessory is widely used in small industrial wood shops for tenoning and grooving operations on duplicate pieces. It's simple to operate and does accurate work. Not too expensive for the homeshop

blades are being used on the arbor with a spacer collar between. In this way cheek cuts for the tenon are made in one pass of the stock. In the detail above at the right the dado head is used to make the first cut of the open mortise. After making the shoulder cuts to finish the tenon you end up with the open mortise-tenon joint shown at the upper left-hand view on the opposite page. All the other joints detailed on that page are quite simple to make on the circular saw, except perhaps the lock joint, which is tricky in that it requires a careful layout to assure an accurate fit. The lock joint is used to some extent in drawer construction, also in joining chest corners. The splined joint and the dovetail dado are not often used in modern cabinet work, but you will sometimes find them detailed in construction drawings of period furniture.

In the detail at the right, Fig. 24, is an example of what is known as pattern sawing. This procedure is used where it is necessary to produce a number of duplicate parts of irregular shape. First cut a pattern the exact shape of the work piece required, and turn two screws into it so that the points project about 1/16 in. Clamp a wooden guide to the ripping fence and set the edge flush with the saw blade. The guide is raised above the saw table a distance equal to the thickness of the material to be cut. Place the pattern over the stock, press down to engage the screw points and then slide the whole thing along the wooden guide with the straight edge of the pattern bearing against the guide.

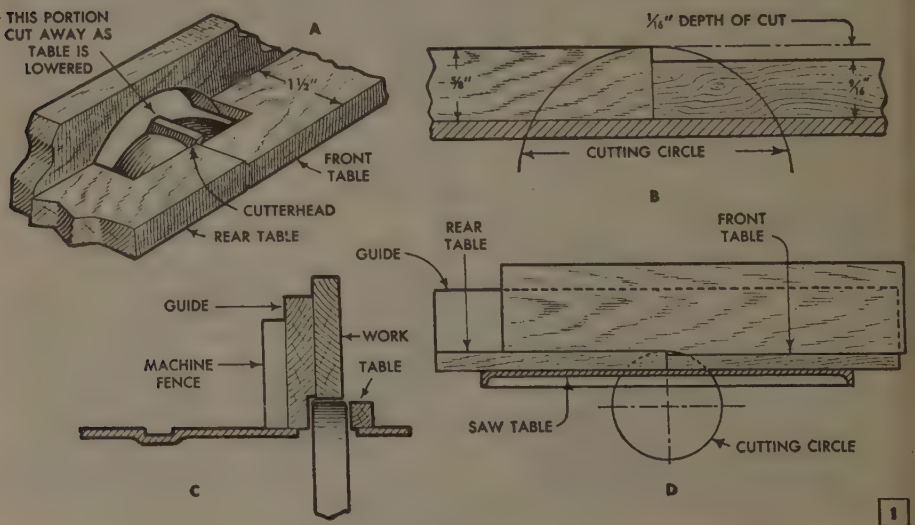


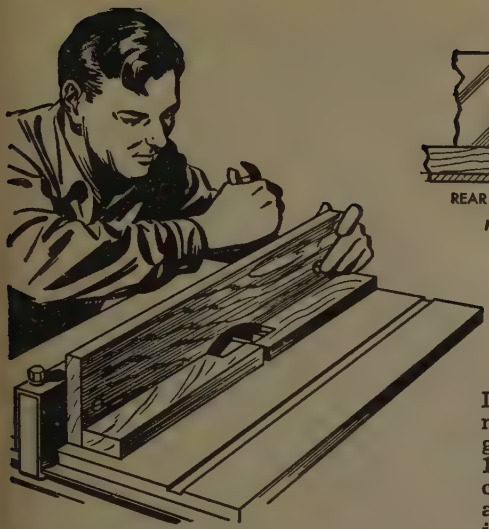
When it is necessary to make a number of irregular-shaped pieces of the same size, small shops do the job by pattern sawing. Procedure is clearly shown

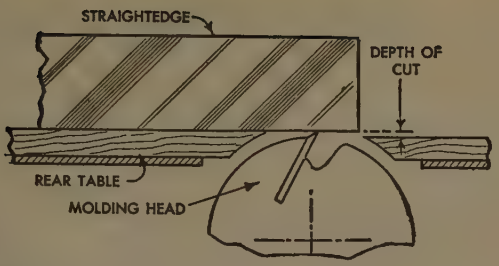
Finally, shift the piece to bring the next flat face of the pattern against the edge of the guide, and repeat the procedure until the work has been cut on all faces of the pattern. Of course, in using this method it is necessary to cut the work to the rough overall size before sawing with the pattern. This permits clearance under the guide.

JOINTER ADAPTER

HOME CRAFTSMEN who do not have a jointer can adapt the circular saw to do the work of this machine on stock not more than 1 in. thick. A three-knife molding head fitted with a set of straight-edged cutters and three pieces of selected hardwood are all the parts needed to make the setup. The auxiliary wooden guide, Fig. 1, detail C, and the infeed and outfeed tables can be made any convenient length. On most saw tables, it will be necessary to plane the outfeed table to a thickness of ⅝ in. and the infeed table to a thickness of 9/16 in. in order to bring the cutting circle to the proper height, as in Fig. 1, detail B. Attach the two tables to the guide with screws. Then attach the unit to the ripping fence with screws or bolts. The meeting ends of the front and rear tables should be directly over





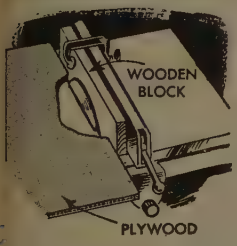


2

the center of the saw arbor as in Fig. 1, details B and D. Remove the saw-table insert, place the molding head on the arbor, and raise the saw table to its highest position. Move the ripping fence to the left until the inner edge of the wooden guide is flush with the outer edge of the cutters on the molding head. Then lock the ripping fence at both ends, start the motor, and lower the saw table slowly until the molding head cuts through the tables. Stop the motor and again raise the saw table to its full height. Slide the ripping fence to the left until the corners of the molding cutters will just clear it. Again start the motor and lower the saw table the same distance as before.

In this step, the molding cutters will remove a semicircular section of the wooden guide, leaving an opening like that in Fig. 1, detail A. This opening allows plenty of chip clearance. The width of the opening also permits adjustment of the head when jointing thin stock. Each time the attachment is used for jointing, the cutters must be set for proper height with a straightedge as in Fig. 2. Raise the table to the full height, place the straightedge on the outfeed table and turn the cutterhead until one cutter is in the vertical position as shown. Then lower the table until the straightedge just touches the edge of the cutter. When correctly located, each cutter will catch the straightedge and move it forward about ⅛ in. when the cutterhead is turned slowly. When jointing, hold the stock firmly against the guide and move it slowly and uniformly over the tables. Be sure the ripping fence is locked securely at both ends of the saw table.

Bench Saw Pinch-Hits as "Jointer"

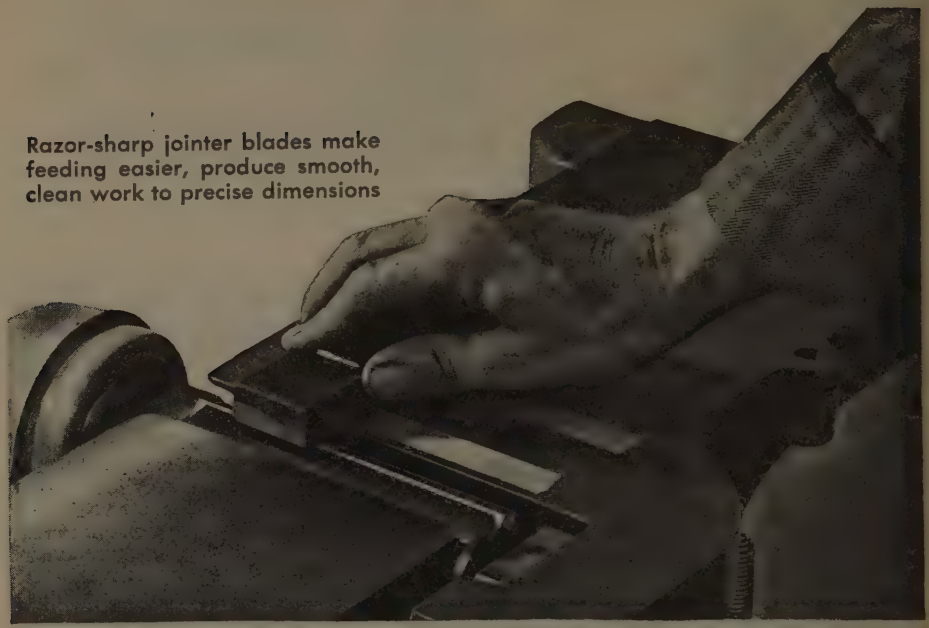


If you don't have a jointer and are confronted with the task of edge-planing plywood panels, a slotted block, employed as a depth stop will permit your bench saw to do the job. As shown in the sketch, a block of ¾-in. stock is trimmed to height of the saw fence. Then, using the fence as a guide, the block is lowered onto the saw blade to cut an arc one half the thickness of the blade in the side of the block. The block is clamped to the saw fence after which the edge of the plywood is guided along the block. This allows a skimming cut to be made by the exposed portion of the blade.

Magnet Holds Jointer Blades When Resetting in Head

The job of installing jointer blades can be made easy by using a strong magnet such as one from a magneto. This is laid on the rear table to extend over the opening, where it will suspend each blade for tightening in exactly the same position.

JOINTER SHARPENING

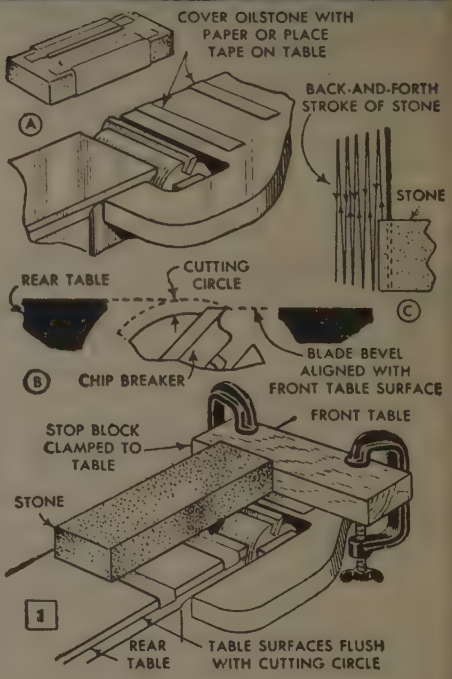


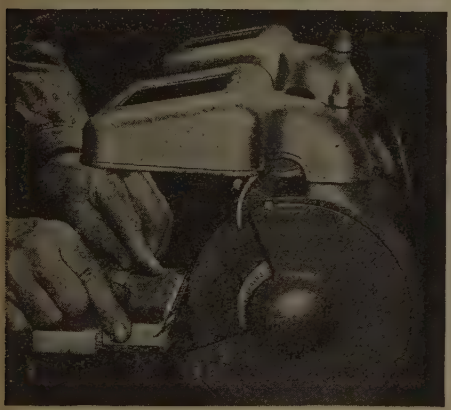
Razor-sharp jointer blades make feeding easier, produce smooth, clean work to precise dimensions

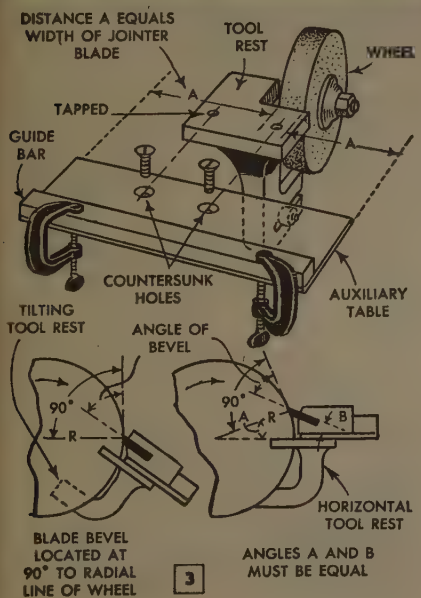
BY REGULARLY observing a few simple precautions you can keep your jointer cutting smoothly over a much longer period of time between sharpenings. Always brush abrasive dust and grime from the stock to be planed, using a wire brush. Don't plane wood on which there are traces of plaster or cement, or grains of sand and check used stock carefully to remove any embedded particles of metal.

Hand honing: When jointer blades have lost their keen edges they can be restored without removing from the head by hand honing the edges with a fine oilstone as in detail A, Fig. 1. Wrap a single thickness of heavy paper around the oilstone and tape it in place as shown or place two strips of masking tape across the table as indicated. Then lower the front table so that its surface lines up with the blade bevel. Wedge the jointer head firmly in this position and stroke the stone over the cutting edge in a uniform back-and-forth motion as in detail C, Fig. 1. Give each blade the same number of strokes. Continue the procedure until the blades are uniformly sharp.

Power honing: Another method of honing, frequently used in woodworking shops, is to hone the blades while the machine is







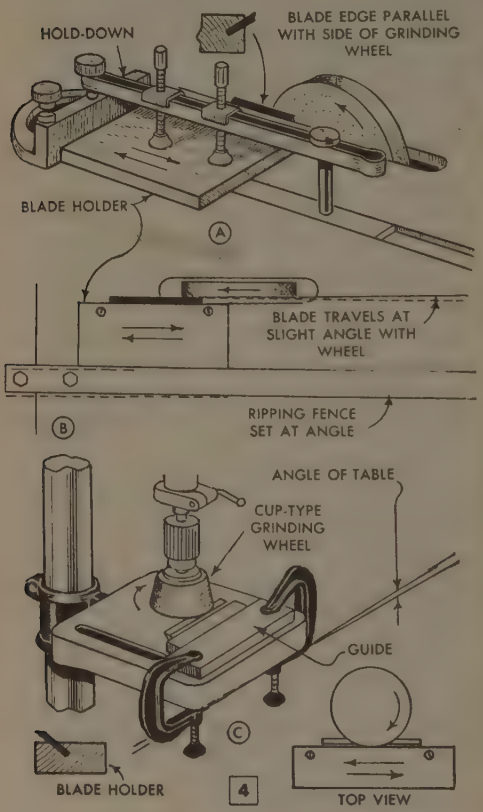
running. Make the setup as in the lower detail, Fig. 1, but raise both tables to the highest point of the cutting arc. Use paper on the stone or tape on the table, as before, to protect the machined surfaces. Then start the machine and lower both tables uniformly until the stone contacts the cutting edges lightly. Move the stone back and forth in a full stroke two or three times, then stop the machine and examine the cutting edges carefully. The new bevel formed by honing should not be more than 1/32 in. wide as otherwise the rear edge of the new bevel may strike the stock.

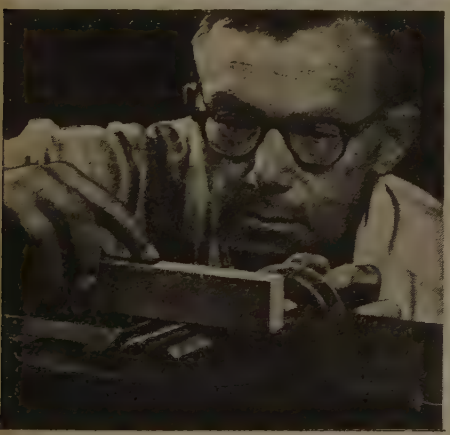
Grinding: After the blades have been honed once or twice and have again become dulled by use, they should be sharpened by grinding. Remove the blades from the cutterhead, as shown in the upper left-hand photo, and then make a hardwood holder of either type shown in details A and B, Fig. 2. The holder having the slot parallel to the sides as in detail A is the one to use when the grinder tool rest can be set at the required grinding angle. Otherwise the blade slot must be cut at the required grinding angle. Clamp screws driven into the wood across the slot hold the blade firmly in place while grinding. If necessary, wedge the blades in place with folded strips of paper as in detail C, Fig. 2. One simple method of determining the correct grinding angle is to place the blade and holder against the ripping fence of the circular saw as in detail D, Fig. 2. Tilt the saw table or the arbor until the blade bevel is flush with the side of the saw blade. The correct grinding angle then can be read on the tilt scale. One simple setup for grinding jointer blades on an ordinary bench grinder having a tilting tool rest is detailed in Fig. 3. As most bench grinders have only a small tool

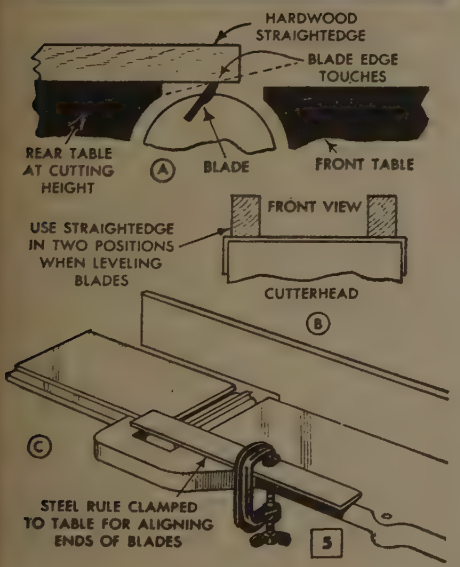
rest it is necessary to provide an auxiliary table of sufficient size to support the blade holder and permit it to be moved right and left a distance equal to the width of the blade. Drill and tap the tool rest for ¼-in. cap screws and, after attaching the auxiliary table, clamp a guide bar or strip to its lower edge. An important point in connection with grinding is the location of the bevel of the blade in relation to the radial line of the grinding wheel. Note in the two lower details in Fig. 3 that the radial angles must be equal when either the horizontal or tilting-type tool rest is used. It is best to use a 6-in.-dia. grinding wheel as otherwise the blades will be hollow-ground more than is permissible. When grinding, keep the blade moving slowly in a uniform stroke to right and left, and dip it in lukewarm water at regular intervals to prevent overheating. To obtain a slight feed for each succeeding stroke, insert a strip of paper between the blade holder and the guide bar. Be sure to use the same number of strips for each blade.

Grinding on circular saw: If you don't have a bench grinder, you can set up the circular saw to grind jointer blades as in Fig. 4, details A and B. If you use the straight-blade holder, the saw table or the arbor must be tilted as in the upper photo at the right of Fig. 4. With the angle holder use the setup shown in detail A or B, Fig. 4. Note that when the ripping fence is used as a guide, detail B, it must be set at a slight angle to the side of the grinding wheel.

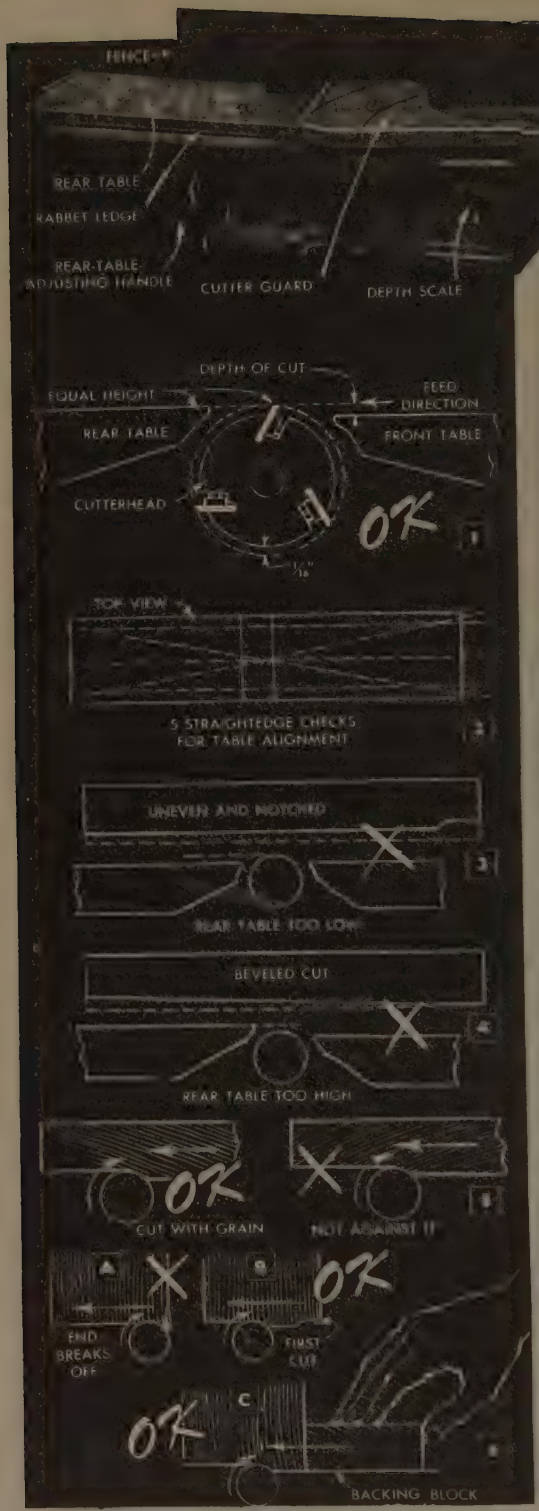
Grinding on drill press: When fitted with a cup-type grinding wheel the drill press can be utilized for sharpening jointer blades. The setup is quite simple and accurate, the blade holder being slotted at an angle with the face of the stock as in the sectional view, detail C, Fig. 4. Note that the drill-press table is tilted at a slight angle so that only the edge of the wheel contacts the jointer blade. In this case the blade is moved from left to right only. After one pass under the wheel the holder is lifted from the table and returned to the original position at the left of the grinding wheel. Before making the first pass of the blade be sure that the drill-press quill is locked firmly in position so that it just contacts the face of the beveled edge of the blade.







Remounting blades in cutter head: Before replacing the blades, be sure to remove the burr from the edge by drawing the flat side of the blade over a slipstone as in the upper left-hand photo. Some woodworkers, requiring exceptionally fine work, hone the cutting edges after grinding. This is done freehand, using a hard slipstone, and care must be taken not to round the bevel or turn the cutting edge. In replacing the blades in the cutterhead, first set the rear table at the normal cutting height and clamp a steel rule or metal straightedge to the front table as in detail C, Fig. 5, to provide a stop for aligning the blades endwise. Now place the blade in the cutterhead slot, replace the locking bar with the concave edge up and tighten the locking screws sufficiently to hold the blade in place. Be sure that one end of the blade contacts the straightedge lightly. Cut a hardwood straightedge and hold it near one edge of the rear machine table as in the center photo at the left. Raise the end of the blade until the cutting edge touches the straightedge as in detail A, Fig. 5. Place the straightedge at the opposite side of the table and raise the cutting edge to contact. Tighten the locking screws slightly to hold the adjustment. Now, turn the cutterhead slowly by hand to check the setting. If correct, the cutting edges will just touch the straightedge but will not lift it or move it forward as the head is rotated slowly by hand. Set the remaining blades, using the same procedure, and check the adjustment of all three before the final tightening of the locking screws. After tightening the screws, check again to make sure that the setting remains the same. This final setting of the blades is of the greatest importance in obtaining satisfactory operation of the machine. If one blade is lower or higher than the others, either at one or both ends, the machine not only will produce rough work but may vibrate badly due to the unbalanced cutterhead. It also is important to tighten the locking screws to a uniform tension. This assures preservation of the original adjustment and safety for the operator as well. Another good idea is to check the tension of the screws after operating the machine for a short time. As the final step, it may be necessary to reset the pointer on the depth scale. To do this, run a cut to exactly ⅛-in. depth then set the pointer to this reading. On some jointers, the ends of the blades are beveled and ground to a cutting edge for making rabbet cuts. Unless considerable rabbeting is done, it will not be necessary to sharpen these cutting edges each time the blades are sharpened. When necessary to sharpen the edges, grind and hone them freehand but be sure to preserve the clearance angle.



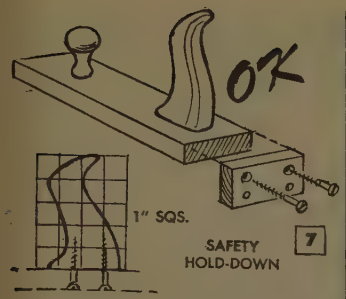
JOINTER TECHNIQUES

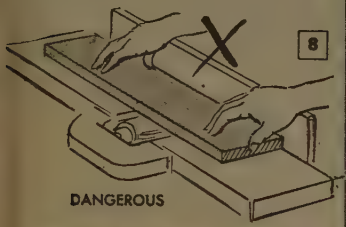
Shows how to cut moldings, tenons, tapers, round and polygon-shaped work, stopped chamfers and recesses

IF YOU HAVE LOOKED upon your jointer as a machine strictly for planing, take note that there's much more to be had from this versatile workshop power tool. In addition to mere edge and surface planing, your jointer can double as an efficient shaper; in fact, some of the jobs it performs cannot be accomplished on any other machine.

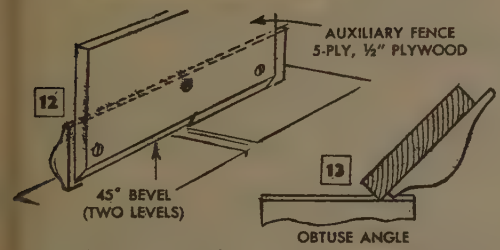
Table alignment: Before a jointer can produce accurate work its tables must be in perfect alignment. For most work, the rear table must be set at exactly the same height as the blades in the cutterhead, Fig. 1, but for all work it is most important that the tops of both tables be in perfect alignment, crosswise as well as lengthwise. Fig. 2 shows how to make a five-way check of table alignment. When the rear table is set too high or too low, notched and tapered surfaces result similar to those pictured in Figs. 3 and 4.

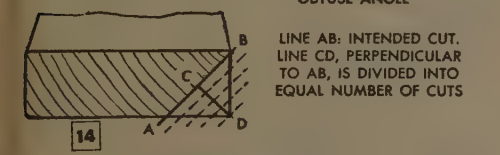
Cut with the grain: Whenever possible, cut with the grain of the wood, not against it, Fig. 5. Where the grain direction changes, especially in the case of birch, beech and cherry, take light cuts and feed slowly. Dull knives cutting against the grain produce a rough surface and require much more pressure on the work than when knives are sharp. Fig. 6 shows the correct way to cut end grain with a jointer. To prevent the wood from splitting at the end of a cut as in detail A, Fig. 6, make it a practice to start the cut at one edge and then reverse the work and cut toward the starting cut as in detail B. Another method

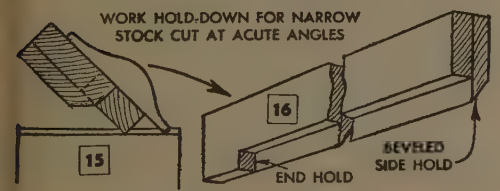




When planing thin stock on a jointer, use a work hold-down as pictured in Fig. 7. Holding the work as shown in Fig. 8 is a dangerous practice which invites serious injury to operator





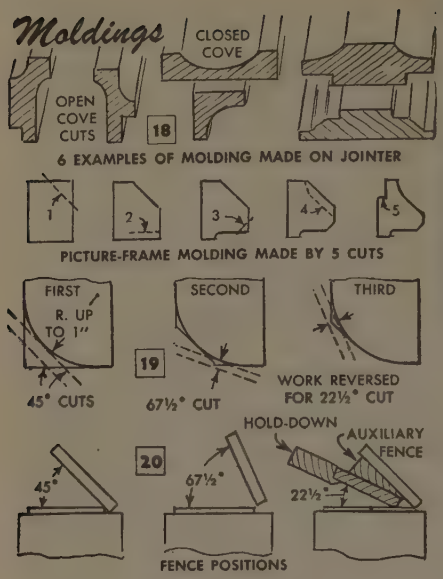


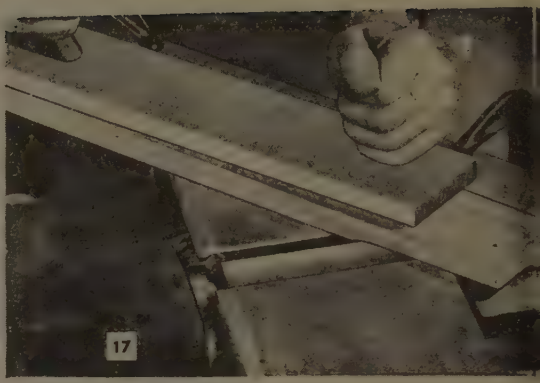
Edge Planing

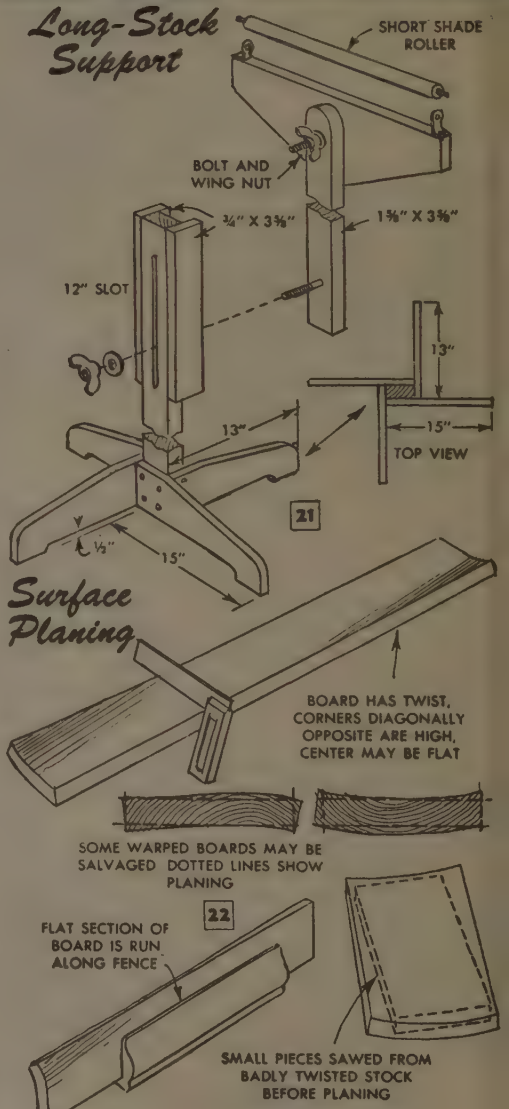
often used to prevent splitting is to back up the edge of the work with a scrap block, as pictured in detail C.

Edge planing: For accurate work in edge planing, the pointer on the fence scale should be set at zero when the fence is at an exact right angle with the front table, Fig. 10. When feeding stock as in Fig. 11, apply just enough side pressure to hold it firmly against the fence, and enough downward pressure to prevent chattering especially on hardwood. Chattering often indicates dull knives. Always make it a practice to keep the cutter guard in place except for certain operations that require its removal.

If the regular fence does not provide sufficient support for wide stock, or stock held edgewise when planing end grain, screw on an auxiliary fence of plywood, Fig. 12. Bevel the bottom edge of the auxiliary fence at a 45-deg. angle, making it conform to the lower edge of jointer fence to provide clearance when cutting acute angles.

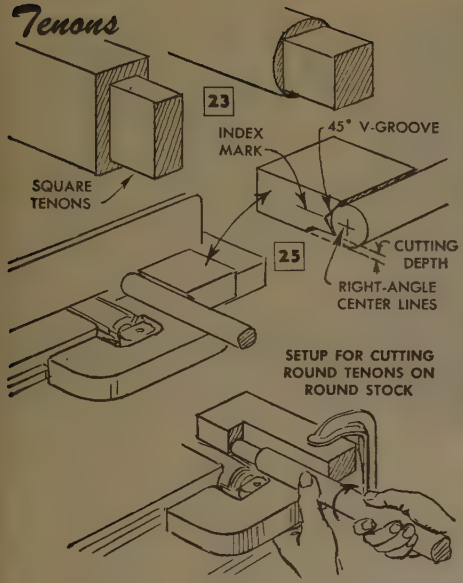






Most jointer fences tilt both ways. When the fence is set at an obtuse angle, Fig. 13, downward pressure on the work is apt to move it away from the bottom of the fence, causing inaccurate work. Therefore, many operators prefer tilting the fence in the opposite direction, Fig. 15. However, this position brings the hands closer to the blades, requiring extreme care, and narrow work should not be planed in this manner without using a work hold-down, Fig. 16, which grips the work at both the side and the end. Whenever angle cuts are made, you can get accurate results by first marking the intended cut on the end of the stock, then marking a perpendicular from this to the corner and dividing this line from corner to curve into equal divisions, Fig. 14. Set the cutter depth to equal one division. Before making the last cut check the remaining stock with the cutter depth.

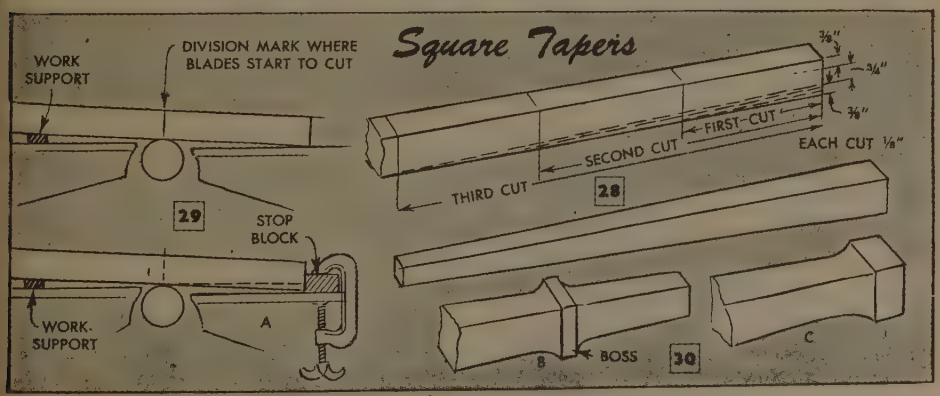
Moldings: Six examples of moldings having straight and cove cuts are shown in Fig. 18. Fig. 19 shows a picture-frame molding formed with five cuts. To make cove cuts, remove the cutter guard and fence as in Fig. 17. Then clamp a straight wooden guide across the front table so that the work may be fed diagonally into the cutter. The work also can be fed parallel to the cutters, in which case each bite can equal only the distance from the blade edges to the cutterhead. When cutting open coves diagonally, the work crosses only part of the cutter. If the straight part of a cove cut is wide enough, it may ride on the rear table which is kept at cutter height. When

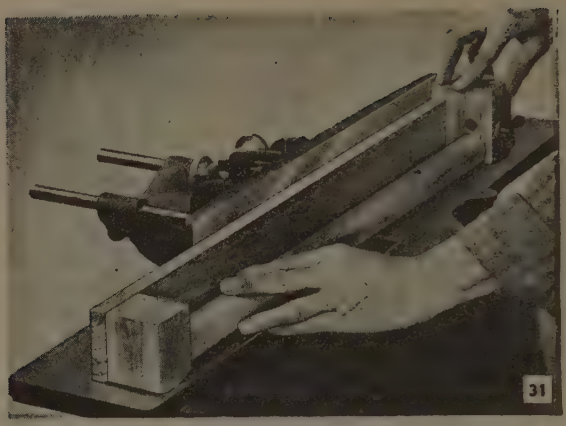


a cove cut is enclosed, Fig. 18, the stock passes over the entire cutter, in which case the rear table must be lowered to the same level as the front table. An enclosed cove will be part of a circle if the work is fed parallel to the cutter blades, but the center of the cut will be flat when the stock is fed at an angle. The width of the flat portion of the cove increases as you approach a right-angle feed. For diagonal cuts particularly, a slow, steady feed is necessary to produce a relatively smooth surface which requires only sanding. The ends and edges of all the cutter blades must be lined up perfectly for best results. Always feed against the cutter, never with it.

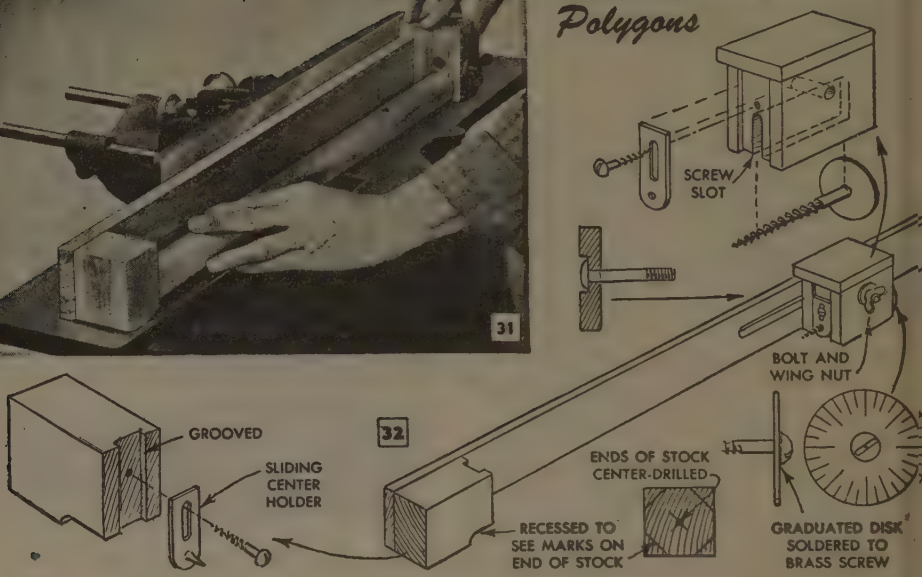
Figs. 19 and 20 show the three steps in rounding an edge at a radius up to 1 in. First scribe an arc on the end of the stock. Then take 45-deg. cuts, followed by a 67½-deg. cut. For the last cut, screw an auxiliary fence to the regular fence, the auxiliary fence being beveled to 22½ deg. on your circular saw. Then set the fence for an acute angle of 45 deg., reverse the work and feed it, using the safety hold-down, Fig. 16. Remove perceptible edges with a block plane and fine sandpaper.

Surface planing: For surfacing long stock and also for edge planing, a pair of roller supports as shown in Fig. 21 is very convenient. They lessen effort and increase accuracy in planing long stock that is so difficult to hold down properly at the beginning and end of a cut. Surface-planing straight stock is relatively easy. Several light cuts always give the best results. If thin stock is wider than the hold-down,





Round Work and Polygons



back it with a thicker piece of the same width. Warped and twisted stock are best surfaced on a regular planer as it is difficult to dress squarely on your jointer. Generally it's best to true one edge first if the sides are not extremely uneven. But sometimes dressing down high spots on sides precedes edge planing. Locate the high spots by sighting with a try square and dress them down with light cuts before planing the entire width. Keep the trued edge firmly against the fence in order to prevent rocking, particularly if the underside of board is rounded. Sometimes badly warped or twisted pieces can be brought down to thinner and narrower pieces that are usable, as shown in Fig. 22.

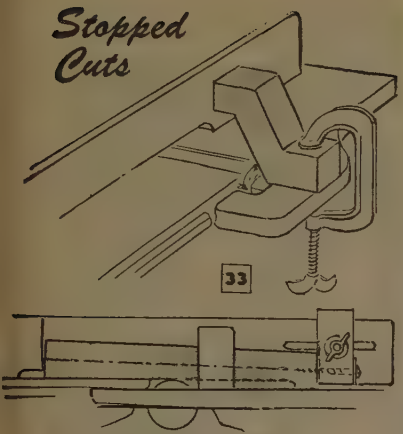
Rabbets and tenons: For cutting rabbets, set the fence the required distance from the ends of the blades near the rabbet ledge, removing the cutter guard. Deep, narrow rabbets may be cut in one pass, wide ones in several passes, lowering the front table with each pass. Stock may be held vertically against the fence or flat on the table.

To cut square tenons as in Fig. 23, set the fence to correct cutting width and then rest the stock against the squared end of a wide piece which is slid along the fence. Square tenons on round stock, Fig. 24, may be cut by holding the stock in a V-groove cut in a block which is slid along the fence. Centered crosslines at right angles are marked on the end of the stock and should line up with the index mark on the block as in Fig. 25. To cut round tenons on round stock, follow the method shown in Fig. 26.

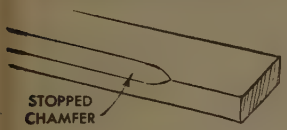
Square tapers: In planing a square taper, as in Fig. 27, first mark the start and the end of the taper and also its depth. Then divide the length into equal parts, each being less than the length of the front table of the jointer. Mark the divisions on all sides of the stock as shown in Fig. 28. The piece illustrated is 1½ in. square and is to be tapered to ¾ in. Therefore, a ⅜-in. thickness must be removed from the end of each side. As the piece is marked off in three divisions, three equal cuts of ⅛ in. each are made. If only the first and second sections were to be tapered, you would take two $\frac{3}{16}$-in. cuts. The first cut starts at the division mark between the first and second sections, with the work just touching the cutter blades as in Fig. 29. A thin support block between the work and the rear table is slid along with the work until the first section gets on the rear table. The second cut is started the same way at the division mark between the second and third sections; the third cut is started at the end of the third section. Each side of the stock is similarly planed.

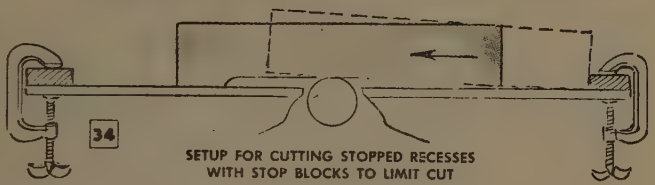
For short, square tapers use a stop block, detail A, Fig. 30, to get tapers on all sides started at the same point. Stopped tapers, forming a raised portion or boss as in de-

Stopped Cuts



ROUND STOCK BEING TAPERED TO CLUBFOOT BY USING STOP BLOCK





SETUP FOR CUTTING STOPPED RECESSES WITH STOP BLOCKS TO LIMIT CUT

tail B, can be made by first tapering the short end on all sides, using a stop block. For successive cuts which form the curved underside of the boss, both tables are lowered the same distance, maintaining their difference in height. When laying out the boss before cutting, remember to make allowance for successive cuts that will reduce the width. Then the rear table is returned to cutter height and the long tapers are made as in Figs. 28 and 29, setting the front table lower to allow for the boss. In this case, a stop block is used at the rear table to limit the travel of the work, so that cutting will stop at the boss. Here, also, successive cuts will narrow the space left for the boss. You can also form club feet on square, tapered legs as in detail C.

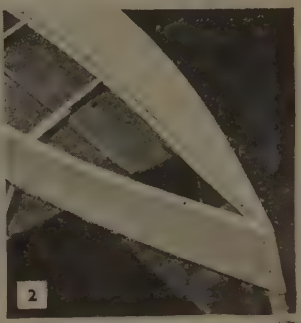
Round and polygon shapes: For planing pieces round or to any polygon shape, use a fixture like the one shown in Figs. 31 and 32. Each end block has a sliding center holder to accommodate different sizes of work and to make adjustments for tapering. Center holes are drilled or punched in the ends of the stock. The side member slides against the fence. The adjustable block does not ride on the front table but the stock projecting beyond it slides on the tables. The center point of the adjustable head is a long screw, the point of which projects through a hole in the sliding center holder so that the screw can turn. A vertical slot permits the screw to be adjusted to various heights. When the screw is driven into the work and tightened, the work is drawn snugly against the block so it will not turn freely, yet can be turned by hand. The cross-sectional shape to be cut is marked on the end of the work. This end goes onto the fixed block, which is undercut to make the marks visible. As an alternative to marking the end of the stock, an indexing disk may be used.

One of the unusual operations on a jointer is the planing of a tapered, round furniture leg having a club foot. First plane the piece round, using the fixture in Fig. 32. Then arrange it for taper planing, but instead of cutting entirely to the end, use a stop block, Fig. 33, to limit the cut and form the club foot.

Stopped chamfers and recesses: You can use your jointer to plane stopped chamfers and recesses. See Figs. 34 and 35. Lower both tables equally to cutting depth. For chamfers, set the fence at a 45-deg. angle. Pencil marks on the fence will serve as guides for starting and ending the cuts, or stop blocks can be used. The latter method is preferable for cutting stopped recesses since the blocks also prevent the work from kicking back when lowered on the cutterhead as indicated by the dotted lines in Fig. 34. To prevent a rough surface at one end of a stopped chamfer or recess where the cutting stops, make two cuts, one from each end to the center ★ ★ ★

KERFING IS THE WAY

to bend wood without steaming

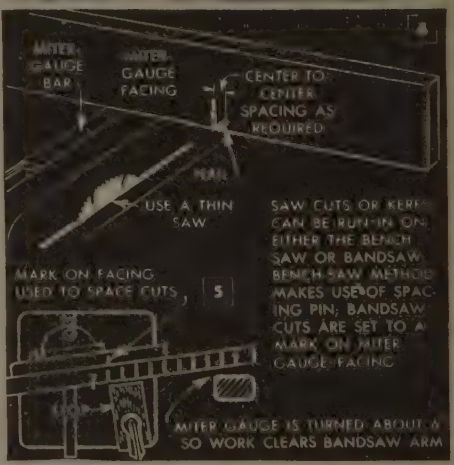


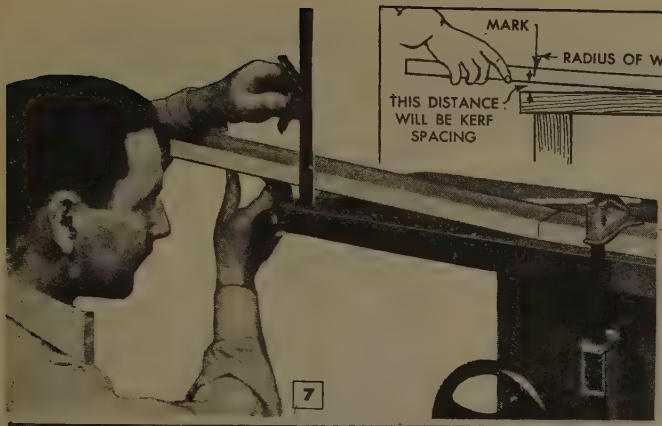
Whether you use a thin-gauge saw, a bench saw or a bandsaw, it's the correct spacing of cuts for the bend that determines an attractive kerfing job

KERFING provides a simple and practical method of bending wood without steaming, and consists of running in a number of saw cuts (kerfs) across the wood to reduce its mechanical thickness. Once used extensively in wooden casket construction, the operation is sometimes referred to as an "undertaker's bend."

The craftsman's usual approach to a kerfing job is to space the kerfs close together and cut the wood as thin as practical. For average work, ¼-in. center-to-center spacing of kerfs is used, while the uncut portion of wood can be as thin as 1/16 in. The job is set up as shown in Figs. 3 and 4, with a nail driven into the miter-gauge facing to space the cuts exactly. A thin-gauge saw is preferable, but equally good work can also be done with any bench-saw blade.

Kerfing also can be done on the bandsaw, Fig. 6, a method which has the advantages of being faster and producing a narrower kerf than a bench saw. The advantage of the narrow kerf is that it can be closed completely when the work is bent and will make the job stronger. When bandsaw kerfing, you cannot make use of the spacing pin, but you can make an equally accurate measure by advancing each kerf as it is cut to a mark on the miter-gauge facing, as shown in Fig. 5. Note that the miter gauge is rotated about 6 deg. to allow the work to clear the bandsaw arm. If you wish to assure yourself that cuts of equal depth will be obtained, it is recommended that a stop be clamped to the saw table.


MITER-GAUGE BAR
MITER GAUGE FACING
CENTER TO CENTER SPACING AS REQUIRED
NAIL
USE A THIN SAW
SAW CUTS OR KERFS CAN BE RUN IN ON EITHER THE BENCH SAW OR BANDSAW. BENCH SAW METHOD MAKES USE OF SPACING PIN; BANDSAW CUTS ARE SET TO A MARK ON MITER GAUGE FACING
MARK ON FACING USED TO SPACE CUTS
5
MITER GAUGE IS TURNED ABOUT 6° SO WORK CLEARS BANDSAW ARM

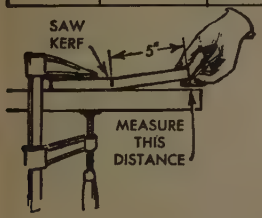


7

SPACING OF CUTS CAN BE DETERMINED BY A SIMPLE SETUP SHOWN. PULL UP GENTLY ON THE WORK AND MEASURE THE AMOUNT OF MOVEMENT AT WORK RADIUS. THIS WILL BE SPACING. IT IS NOT NECESSARY THAT THE KERF CLOSE

8 KERFING TABLE

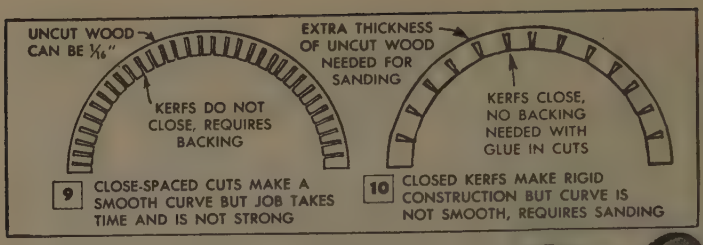
① TEST BEND	② NUMBER OF CUTS IN CIRCLE	③ KERF TO CLOSE	SPACING OF CUTS ④ RADIUS OF WORK IN INCHES												
			3	4	5	6	7	8	9	10	11	12	13	14	15	16
1/8"	258	.018 (1/64)	1/16	3/32	1/8	5/32	5/32	3/16	7/32	1/4	1/4	9/32	5/16	5/16	3/8	3/8
3/16"	171	.027 (1/32)	3/32	1/8	3/16	7/32	1/4	9/32	5/16	3/8	3/8	7/16	9/16	1/2	9/16	9/16
1/4"	129	.036 (1/32)	1/8	3/16	1/4	1/4	5/16	3/8	7/16	1/2	1/2	9/16	5/8	11/16	3/4	3/4
5/16"	100	.047 (3/64) (AV. BAND SAW)	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
3/8"	83	.056 (1/16)	3/16	1/4	3/8	7/16	1/2	9/16	5/8	3/4	13/16	7/8	15/16	1	1 1/8	1 3/16
7/16"	72	.065 (1/16)	1/4	5/16	7/16	1/2	9/16	11/16	3/4	7/8	15/16	1	1 1/8	1 3/16	1 5/16	1 3/8
1/2"	63	.074 (3/64)	1/4	3/8	1/2	9/16	11/16	3/4	7/8	1	1 1/16	1 3/16	1 1/4	1 3/8	1 1/2	1 5/16
9/16"	56	.084 (3/64)	5/16	7/16	9/16	5/8	3/4	7/8	1	1 1/8	1 3/16	1 5/16	1 7/16	1 9/16	1 11/16	1 3/4
⑤ 5/8"	50	.094 (3/32) (AV. CIRC. SAW)	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2
11/16"	46	.102 (7/64)	3/8	1/2	11/16	13/16	15/16	1 1/16	1 3/16	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2 1/16	2 3/16
3/4"	42	.112 (1/8)	7/16	9/16	3/4	7/8	1	1 3/16	1 3/16	1 1/2	1 5/8	1 3/4	1 15/16	2 1/16	2 5/16	2 3/8



1. Test bend is made on scrap piece being worked. Amount of lift at end is value used in first column. 2. This gives number of cuts in a circle. Half circle requires half as many cuts. 3. Width of saw kerf. This column applies only to ¾-in. stock. Kerf can be wider but will not close. 4. Center-to-center spacing of kerfs. Cuts can be spaced closer but not wider. 5. Spacing in this line works out exactly and values are used to check work sizes not listed. A 6-in. radius needs twice the spacing of 3-in. radius. If test bend is 5/16 in., a 12-in. radius requires ¾-in. spacing

HOW KERFING TABLE IS USED

Make a test bend as shown in drawing at extreme left. For maximum strength, leave as much uncut wood as possible. Gradually deepen cut until test piece can be bent ⅛ in. Then find ⅛ in. in column 1. On same line, column 2 shows 258 cuts needed for full circle, or 129 cuts for half circle. Under 12-in. radius column, 9/32 in. is the spacing required. Note in column 3 that the kerf needed to close is 1/64 in. wide. As this is not practical, a wider kerf is used, even though it will not close tightly when stock is bent. Second example of same job: If you want the kerf to close, start with the .047-in. bandsaw kerf in column 3. Then all the figures on this line will apply. Test bend must be 5/16 in. and spacing will be ¾ in. Kerfing is done on the bandsaw as pictured in Fig. 5


UNCUT WOOD CAN BE 1/16"
KERFS DO NOT CLOSE, REQUIRES BACKING
EXTRA THICKNESS OF UNCUT WOOD NEEDED FOR SANDING
KERFS CLOSE, NO BACKING NEEDED WITH GLUE IN CUTS

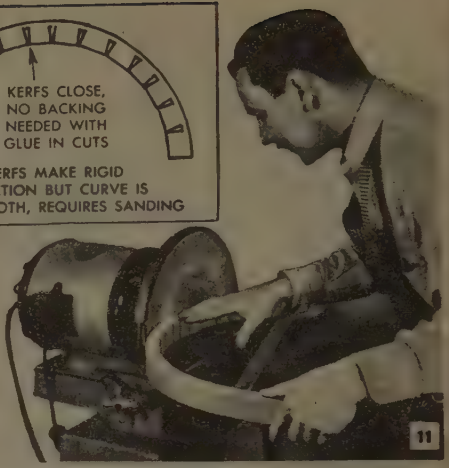
9 CLOSE-SPACED CUTS MAKE A SMOOTH CURVE BUT JOB TAKES TIME AND IS NOT STRONG

10 CLOSED KERFS MAKE RIGID CONSTRUCTION BUT CURVE IS NOT SMOOTH, REQUIRES SANDING

A scientific approach to a kerfing job calls for spacing the cuts exactly as required to make a specified bend. One method to determine the spacing is shown in Fig. 7. First, a test kerf is cut on a scrap board and the board is clamped to a level surface. Then the board is lifted and the amount of lift at the work radius is measured to determine the spacing required. While exact, this method is subject to considerable variance, for the deeper the kerf is made, the more the wood will bend and the wider the spacing will be. You are assured in all cases, however, that if one kerf allows the wood to bend a certain distance at the radius, further cuts will allow the same bend all around and will ultimately make a circle of the specified radius.

All of the various factors in kerfing are brought under control by the use of the kerfing table shown in Fig. 8. By referring to the table, you can control any of the factors which may be needed for a certain job. You can make the kerfs close for maximum flexibility, or determine the maximum thickness of uncut wood which can be left and still permit the bend. Any allowance made should lean to closer spacing than the table shows. The fault of wide spacing is that, while it permits the bend, the curve will form in a series of flat faces, Fig. 10, and may require sanding to bring it to a smooth curve. The advantage of wide spacing is that it allows the kerfs to close; if you run glue into the cuts before bending, the final product will be a bent piece of wood capable of standing alone. On the other hand, close-spaced kerfs, Fig. 9, consume time and the job is not strong. They must always be backed by a number of glue blocks as shown in Fig. 12.

After the kerfing is completed, the actual bending of the wood should be done gradually to avoid any danger of splitting. Give the work a comfortable bend and span a piece of wood across it to hold the shape, Fig. 13. After setting to this curve for an hour or two, the work can be given another bend. Sometimes it is necessary to sponge the work for about five minutes with warm water, as shown in Fig. 14. This will allow nearly double the bend possible with dry wood, a fact which should be kept in mind when determining the kerf spacing.



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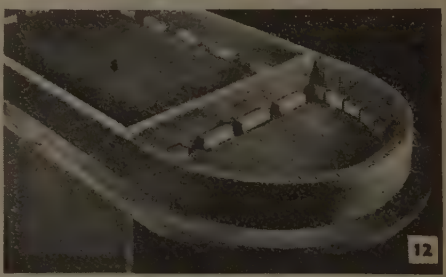
Sanding work is required when kerfs are wide-spaced



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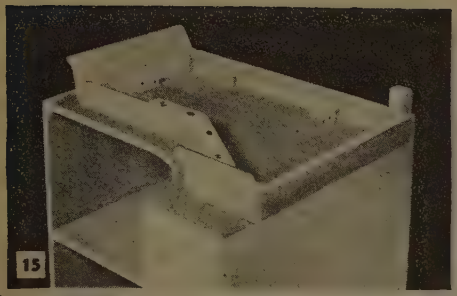
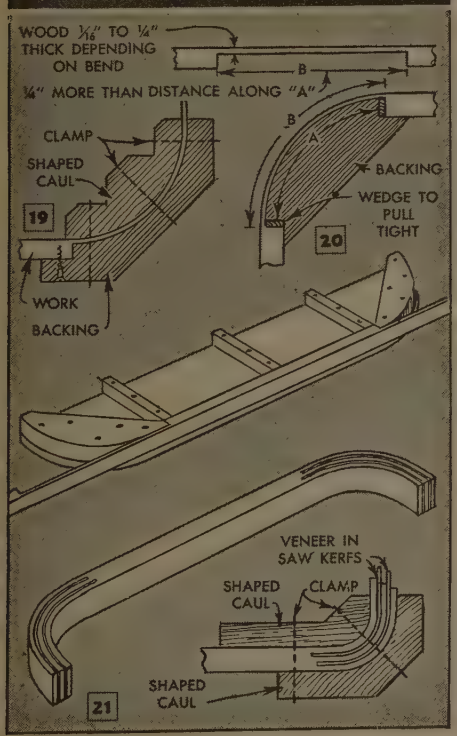
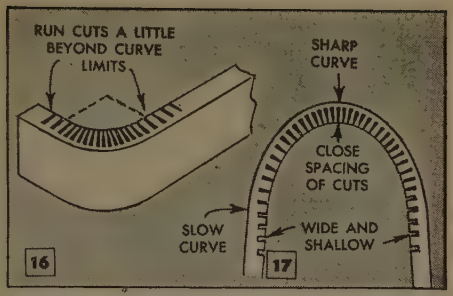
13

14



The thin-section method of producing bent work can be used for forming both inside and outside curves





Kerf spacing is always uniform if the curve is uniform. On slight bends, however, the spacing may vary. Fig. 17 is an example—closely spaced cuts are used to make the sharp bend, while a few widely spaced cuts serve for the flat curve. Fig. 1 is an example of a flat bend where two or three cuts about halfway through the wood are enough to take the strain off the wood. The job shown in Fig. 2 makes use of a number of uniform and closely spaced kerfs cut very shallow; the idea is to reduce the effective thickness of the wood to make a more comfortable bend. Fig. 16 shows a quarter-round curve with kerfing extending beyond the curve limits.

An alternate to kerfing for most bent work is the technique of thinning the wood, as shown in Figs. 15 and 18 to 20 inclusive. Like close-spaced kerfing, this work always requires a backing, which, in this case, must be a solid block of wood or an equivalent built-up backing. The thin section is glued to the backing, necessitating the use of a shaped caul or pressure block in the clamping operation, as shown in Fig. 18. This is an example of an inside curve; Fig. 20 is an example of an outside curve. When one end of the thinned section is free, the shoulder is butted tightly against the backing block; when the work does not have a free end, it is more practical to cut the thinned section a little overlength to permit stretch-fitting with wedges.

Still another technique used for bent work is kerfing lengthwise with the work, as shown in Fig. 21. The cuts should be run in on the bandsaw with the use of a ripping fence and can be spaced to suit. Dependent on the sharpness of the curves and the number of kerfs, work of this kind may require some steaming. Strips of veneer are placed in the saw kerfs and the work is clamped without glue, using hot-water sponging or steam if needed. After the work has dried, the clamps are released and the permanent assembly made with glue. Although this method of bending is more work than the other systems, it has advantages in that the work will stand alone and the edge can be exposed.

Photo courtesy makers of Armstrong linoleum

Remodeling can transform your old kitchen into one of glamorous beauty and step-saving efficiency, with plenty of cabinet and counter space, work-saving appliances, spot and general lighting, colorful floor and walls

KITCHEN PLANNING

MODERN, STREAMLINED KITCHENS are amazing improvements over those of grandmother's day, and even over those of 10 and 15 years ago. It is no wonder then, that the kitchen usually is the first room that is contemplated for major improvement. An old kitchen brought up to date with improved facilities means much less work and more pleasant surroundings. Modern equipment eliminates most of the stooping, reaching and stretching necessary in older kitchens. The biggest chore — dishwashing — now can be done automatically, and with a maximum degree of sanitation. It is only necessary to scrape off the leavings from plates and utensils, place them in a dishwashing unit, and turn on the switch. The cycles of washing, rinsing and drying follow each other without your attention.

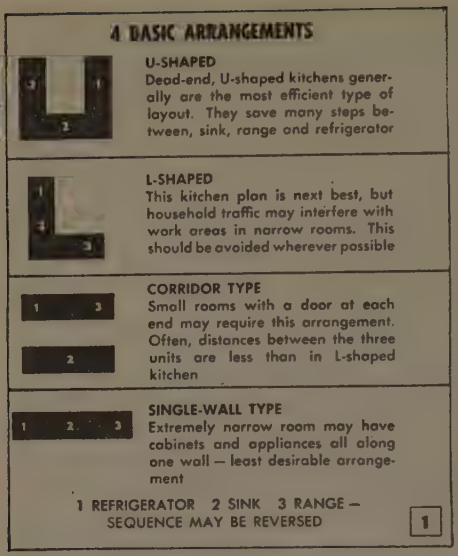
Most older kitchens are inefficient because they are not arranged to conform with the natural sequences in which food is brought into the kitchen, stored and then prepared for consumption—a sort of production-line sequence. In such a kitchen countless steps and time are wasted. Another major fault of many older kitchens is the limited amount of storage and counter space, and the inconvenient location of dishes, utensils and supplies, which should be almost within arm's reach from the point where they are needed. Often an old kitchen can be made much more convenient by simply rearranging the existing facilities and adding more cabinet and counter space. The appearance of counters, as well as that of walls and floors, can be improved greatly by using durable, attractive coverings now available in many colors and designs.

The cost of modernizing a kitchen will vary with the number and kind of improvements installed. Where a large expenditure is made for equipment, you can make a saving by installing it yourself. You may also be able to build some of the cabinets, breakfast nook, snack bar, and other

Photo courtesy Pittsburgh Plate Glass Co.

Many different kinds of materials are used in styling smart, modern kitchens for various effects. Walls may be of sparkling structural glass in color, or may be of beautifully grained wood for cozy, colonial effect

Photo courtesy Western Pine Assn.


4 BASIC ARRANGEMENTS
U-SHAPED
Dead-end, U-shaped kitchens generally are the most efficient type of layout. They save many steps between, sink, range and refrigerator
L-SHAPED
This kitchen plan is next best, but household traffic may interfere with work areas in narrow rooms. This should be avoided wherever possible
CORRIDOR TYPE
Small rooms with a door at each end may require this arrangement. Often, distances between the three units are less than in L-shaped kitchen
SINGLE-WALL TYPE
Extremely narrow room may have cabinets and appliances all along one wall — least desirable arrangement
1 REFRIGERATOR 2 SINK 3 RANGE — SEQUENCE MAY BE REVERSED
1

equipment yourself, which represents a further saving.

The first essential is good planning. After getting acquainted with the requirements of a modern kitchen, you plan to meet these in the space that you have available. Time spent in planning can eliminate many errors. Perhaps existing plumbing lines can be utilized without appreciable change. However, don't hesitate to have them extended to locations that are better suited to producing a more efficient kitchen. Added electrical outlets may also be needed. All work of extending the wiring and plumbing lines should be done prior to the installation of cabinets.

Four basic arrangements: Today's kitchens are based on the four basic arrangements shown in Fig. 1. You can approximate one of these even if the shape of your present kitchen cannot be altered. Keep in mind that in every kitchen there are three centers of activity: 1—storage, 2—preparation and cleaning, 3—cooking and serving. All of these centers include vital appliances

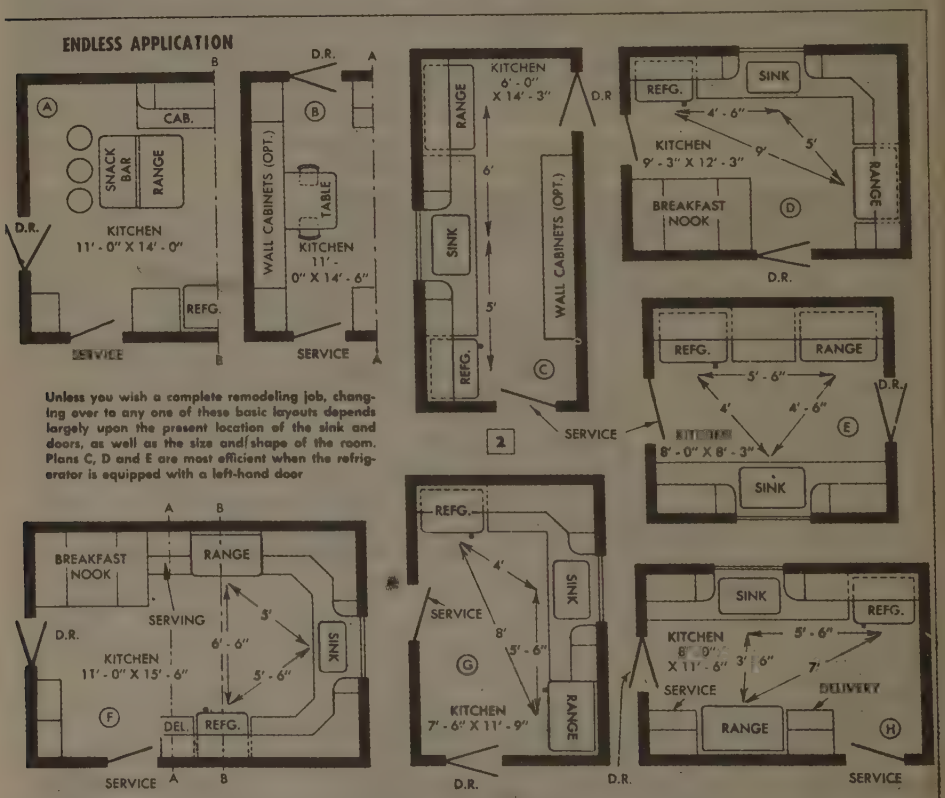
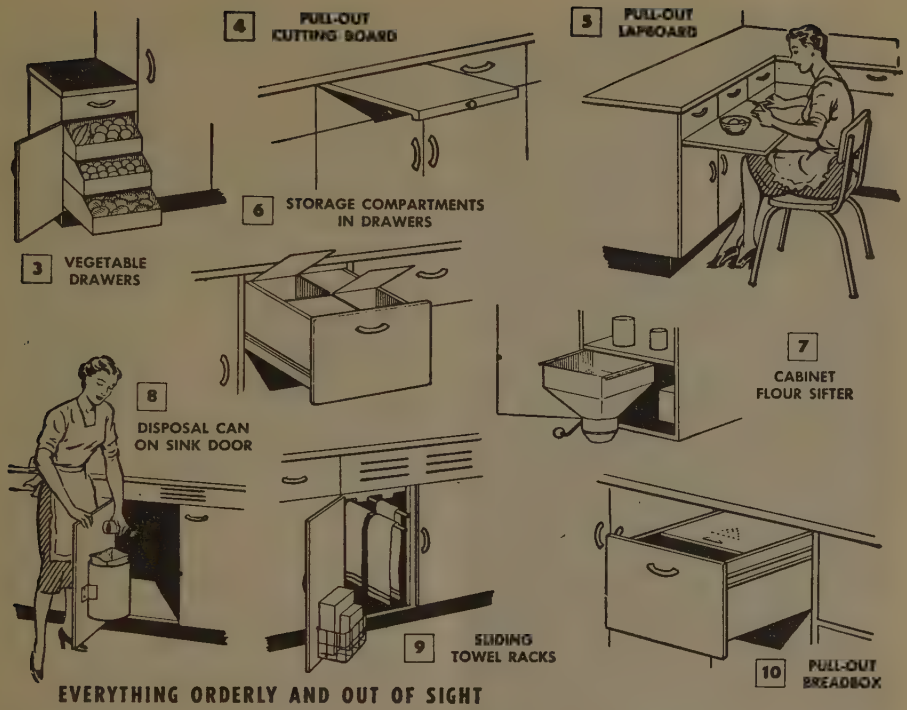

ENDLESS APPLICATION
CAB.
SNACK BAR
RANGE
KITCHEN 11' - 0" X 14' - 0"
REFG.
SERVICE
D.R.
WALL CABINETS (OPT.)
TABLE
KITCHEN 11' - 0" X 14' - 6"
KITCHEN 6' - 0" X 14' - 3"
SINK
WALL CABINETS (OPT.)
KITCHEN 9' - 3" X 12' - 3"
BREAKFAST NOOK
4' - 6"
9'
5'
6'
5'
4'
4' - 6"
5' - 6"
8' - 0" X 8' - 3"
KITCHEN 8' - 9" X 11' - 6"
3' 6"
7'
DELIVERY
KITCHEN 7' - 6" X 11' - 9"
8'
5' - 6"
KITCHEN 11' - 0" X 15' - 6"
SERVING
3'
6' - 6"
5' - 6"
DEL.
Unless you wish a complete remodeling job, changing over to any one of these basic layouts depends largely upon the present location of the sink and doors, as well as the size and shape of the room. Plans C, D and E are most efficient when the refrigerator is equipped with a left-hand door
2

FIG. 2


4 PULL-OUT CUTTING BOARD
5 PULL-OUT LAPBOARD
6 STORAGE COMPARTMENTS IN DRAWERS
3 VEGETABLE DRAWERS
7 CABINET FLOUR SIFTER
8 DISPOSAL CAN ON SINK DOOR
9 SLIDING TOWEL RACKS
10 PULL-OUT BREADBOX
EVERYTHING ORDERLY AND OUT OF SIGHT

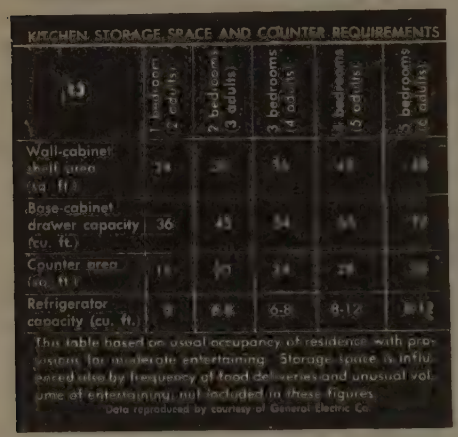
and cabinets placed in a production-line sequence so that kitchen operations can proceed orderly from storage to the dining table. The line starts at the service door where food is delivered, and ends at the nearest point to where food is served. A, B and C of Fig. 11 indicate the paths of walking in a kitchen. It is important that these be as short as possible over the usual minimum of 4 ft. to save steps, especially distance B, between sink and range, where most walking is done.

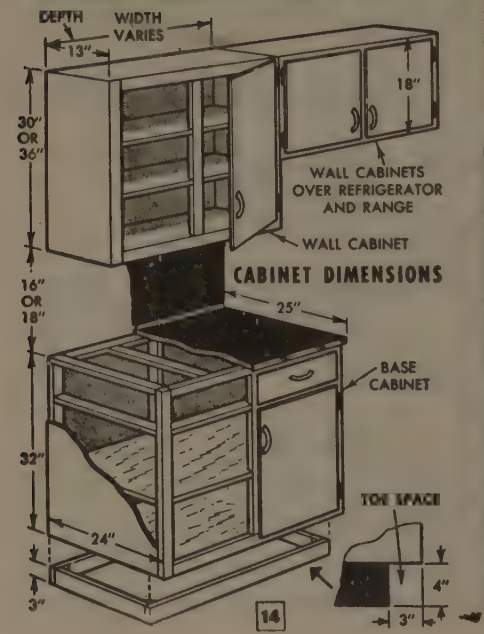
By studying the typical kitchen layouts shown in Fig. 2, you'll find one that is most adaptable to the shape of your present kitchen. The new arrangement will depend largely on the location of the sink as extensive plumbing changes are expensive, although pipes can be shifted about 8 in. in either direction at small cost. A dead-end, U-shape kitchen generally is the most efficient. See Plan F of Fig. 2. Two alternate arrangements of one end are shown at A and B. If the room is less than 11 ft. wide, the two wall cabinets on the same wall as the window are eliminated and the width of base cabinets along this wall is reduced. Then the plan will fit an 8 or 9-ft. kitchen width but the alternate arrangements at A and B may not be possible. If your kitchen is 4 or 5 ft. shorter than the plan shown at F, the breakfast space may have to be sacrificed.

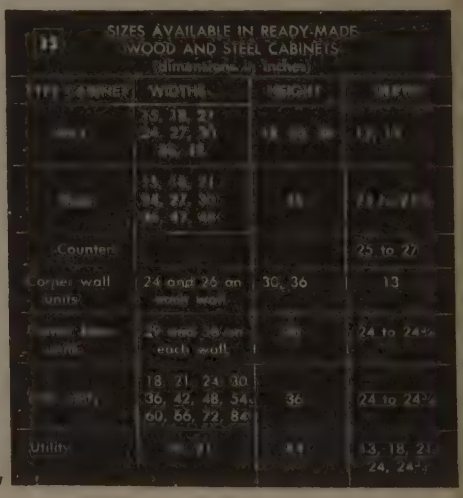
Storage center: Counter space of at least 18 x 24 in. should be provided next to the refrigerator on the side where the door opens. This is for deliveries as well as for food to be removed from or returned to the refrigerator. Cabinet storage space

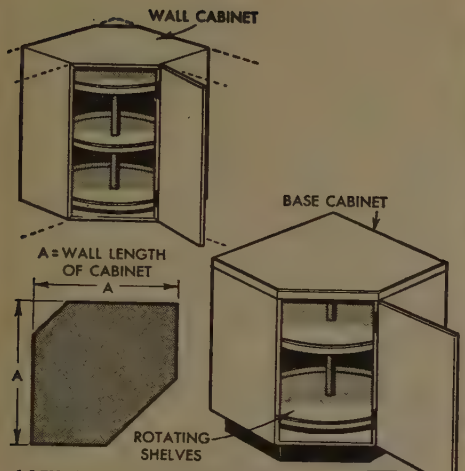
should be within arm's reach of this counter. If you have a home freezer cabinet, it should be placed next to the refrigerator if space permits. For vegetables and fruits, a near-by base cabinet should contain a tier of easy-sliding, ventilated drawers, Fig. 3. Flour, sugar, etc., can be kept in a drawer having metal containers as in Fig. 6. Or, you may prefer to keep flour in a sifter that slides into a wall cabinet as in Fig. 7. Some cereals and condiments may be kept in wall cabinets most convenient to points where food is prepared. Always keep in mind that supplies should be stored close at hand where they are first used.

Preparation and cleaning center: This includes counter space of not less than 24x36 in. at one or both ends of the sink. For cutting, you can install a slide-out hardwood leaf, Fig. 4, or a slide-out lapboard, 26 to 28 in. above the floor, for working in a seated position as in Fig. 5. Processing equipment is stored in drawers or on shelves of base cabinets along the preparation counter. Counter space where dishes are stacked for washing should not be less than 24x36 in. This may be the same counter used for food preparation. It will be on your right when facing the sink if you wash dishes, from stacking to storing, in a right-to-left sequence. Then the cabinets where dishes are stored should be at your left, so they can be dried and put into the cupboard. Cutlery goes into partitioned drawers near by, and cooking utensils preferably on easy-sliding shelves or drawers in base cabinets. Dishwashing equipment is stored under the sink and this space may include one or more sliding towel racks as in Fig. 9. Convenient disposal cans may be fitted on the sink-cabinet doors as in Fig. 8—one provided with a waxed-paper


KITCHEN STORAGE SPACE AND COUNTER REQUIREMENTS
13
1 bedroom (2 adults)
2 bedrooms (3 adults)
3 bedrooms (4 adults)
4 bedrooms (5 adults)
5 bedrooms (6 adults)
Wall-cabinet shelf area (sq. ft.)
24
Base-cabinet drawer capacity (cu. ft.)
36
45
54
64
77
Counter area (sq. ft.)
Refrigerator capacity (cu. ft.)
6-8
8-12
This table based on usual occupancy of residence with provision for moderate entertaining. Storage space is influenced also by frequency of food deliveries and unusual volume of entertaining, not included in these figures.
Data reproduced by courtesy of General Electric Co.







LAZY SUSAN IN CORNERS 16

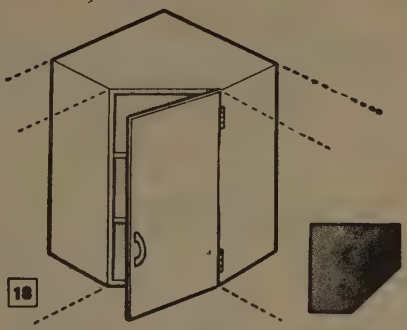
17

bag to catch refuse, and the other for empty cans, jars and bottles. If you go beyond the manual dishwashing stage, you'll install an electric dishwasher and perhaps also a motorized disposal unit.

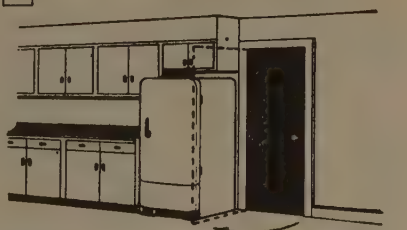
Cooking center: The cooking range should be located conveniently near the dining-room door, breakfast nook or both. A counter not smaller than 24x24 in. should be placed next to the range to facilitate transferring cooked food to serving dishes. Base cabinets near the range can hold some of the heavy cooking utensils. Bread and bakery goods are kept near the range in a special metal-lined drawer similar to the one in the drawing in Fig. 10.

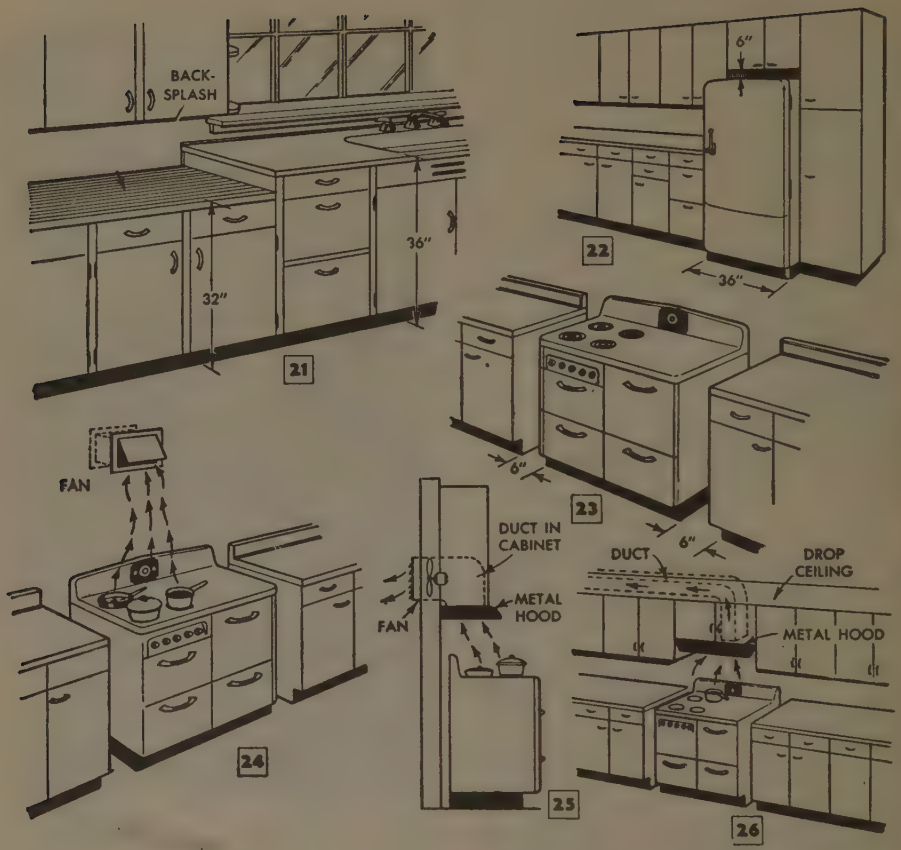
Planning center is optional: If space permits, you can have a planning center. A drop-leaf table 30 in. high and a stool or chair that slides under it are provided as in Fig. 12. An open wall shelf holds a small radio and cookbooks so that the table can be pulled out into the room and used for other purposes. A shallow drawer keeps pads, pencils and bills out of sight.

Figuring storage space: When planning a new kitchen, first determine the storage and counter space needed. This varies with the size of the house and the family (see Fig. 13). Compare your figures with the measurements of base and wall cabinets given in Figs. 14 and 15 so that you can work out cabinet and counter dimensions to suit. Ready-made wooden and steel cabinets are available in the sizes given in Fig. 15. If the kitchen is larger than needed, only part of it may be required, leaving space for a breakfast nook or snack bar as suggested in Fig. 2, plans A, B, D and F. Corner space can be utilized to best advantage by using corner cabinets, available


18

19 DOOR SWINGS AGAINST CABINET


20 DOOR SWINGS AGAINST SIDE OF REFRIGERATOR



in both wall and base types. These have doors at a 45-deg. angle to the walls as in Fig. 18. Some types are available with rotating shelves, as in Fig. 16, which further increases their convenience. A utility cabinet for brooms, dust mops and vacuum cleaner, and a cabinet for clothes and rubbers, can be included in your kitchen plans. Also include a built-in ironing board if the kitchen is to be used for ironing.

Planning with scale models: An excellent method of crystallizing a plan is to draw the floor space of your present kitchen to scale, say ½ in. to 1 ft., including the exact position of the sink, doors and windows. Then cut out, also to scale, cardboard strips representing the range and refrigerator, and two strips representing the total length of the wall and base cabinets required. After positioning the range and refrigerator at the right locations, cut up the cabinet strips to fit between and adjacent to them. Clearance between counters facing each other should not be less than 4 ft.

Windows and doors: Sometimes, for best results, it may be advisable to have a carpenter change the location of a window or door—or just the direction the door swings. Windows in frame houses are easier and less expensive to change than those in brick houses. For adequate illumination, the window area of a kitchen should not be less than 20 percent of the floor area. One counter at least, preferably the preparation and cleaning counter, should be well lighted from a window. Most women prefer to have a sink at a window but this is not essential in a well-planned, efficient kitchen. Windows never should be "boxed in" by wall cabinets. A much better appearance results when cabinets are spaced about 9 in. from the window edges and rounded shelves are installed as shown in Fig. 17.

Changing the position of a door entails considerable mess. A door should not swing into a work area or interfere with the use of cabinets and appliances as in Fig. 19. Nor should a door swing against an open

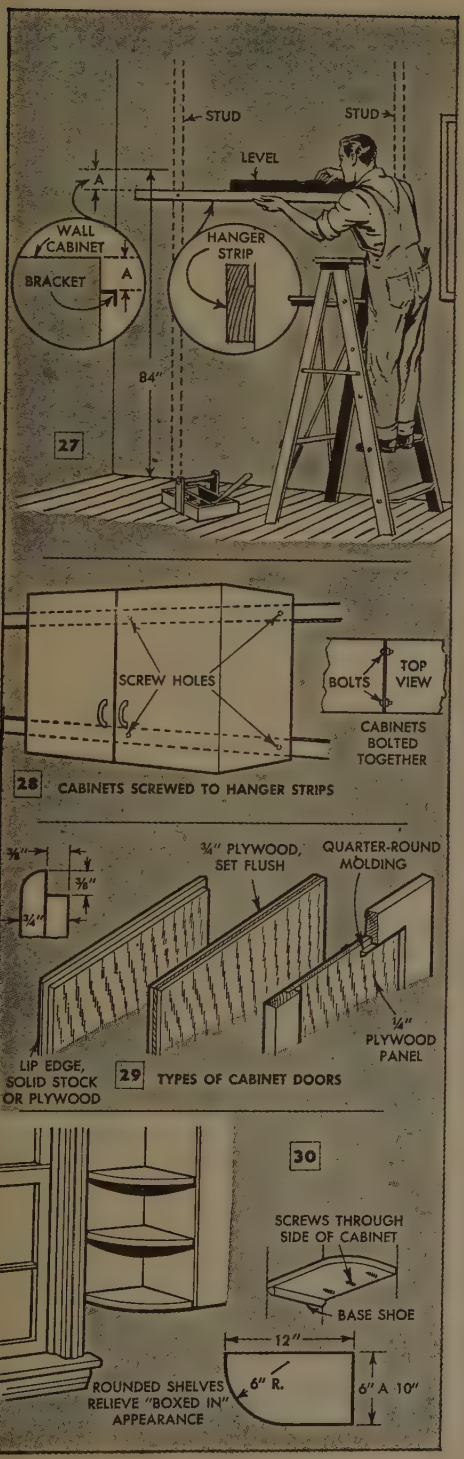


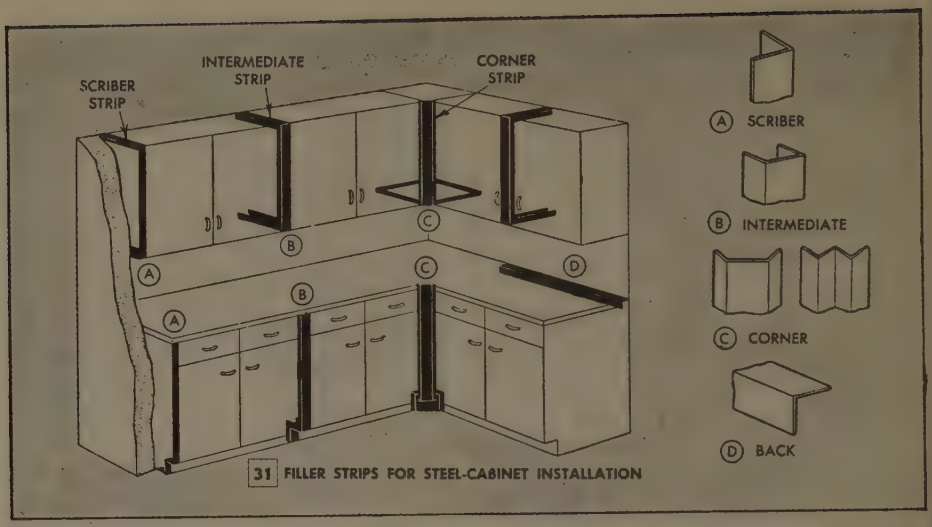
Illustration courtesy A. J. Lindemann & Hoverson Co.

Wall or cabinet oven has an infra-red ray broiling unit, a stainless-steel front and automatic controls

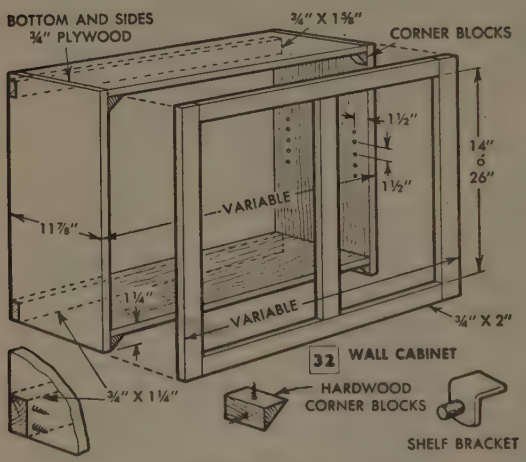
wall which should be used for a necessary cabinet. A door may swing against the end of a cabinet or appliance as in Fig. 20. Two doors are preferred to three, especially in small kitchens. If possible, they should be located so that household traffic will not cross kitchen work areas, as indicated by the arrow in Fig. 11 and also in the floor plans A, B and F in Fig. 2.

Cabinet heights, clearances, spacing: Base cabinets should have toe space 4 in. high and 3 in. deep to facilitate working at counters without leaning. Standard height of base cabinets is 36 in. although the food-preparation counter, or part of it, may be lower to suit the user. A 32-in. height here suits the average woman. Glued-up hardwood tops are available as shown in Fig. 21. There should be a clearance of 15 to 18 in. between counters and wall cabinets.

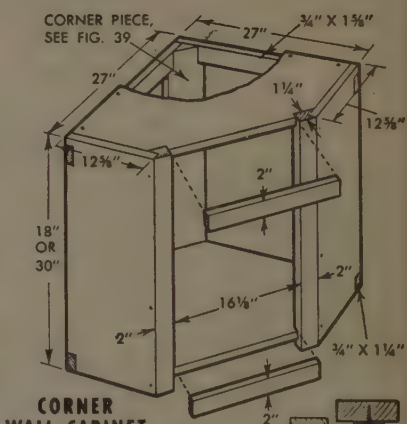
Wall space over sinks and counters should be protected with a backsplash, Fig. 21, not less than 4 in. high and preferably extending from the counter to the wall cabinets. When planning cabinets, a space 36 in. wide generally is allowed for a refrigerator, with a 6-in. clearance above it, Fig. 22. Most kitchen ranges are of the 36 or 39-in. size. Normally, a 42-in. space is allowed to accommodate them but if the range is set between cabinets, or a cabinet and a wall, this allowance is not enough to permit cleaning the sides of the range. A 6-in. space at each end as shown in Fig. 23 is better. A 30-in. wall cabinet may be set over an electric range with the usual 18-in. clearance. Gas ranges, however, require at least a 30-in. clearance because of their greater fire hazard. This still permits the use of 18-in. wall cabinets over them, if necessary, but none at all is preferable.



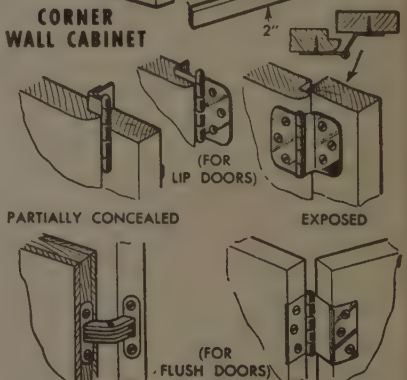
31 FILLER STRIPS FOR STEEL-CABINET INSTALLATION



32 WALL CABINET



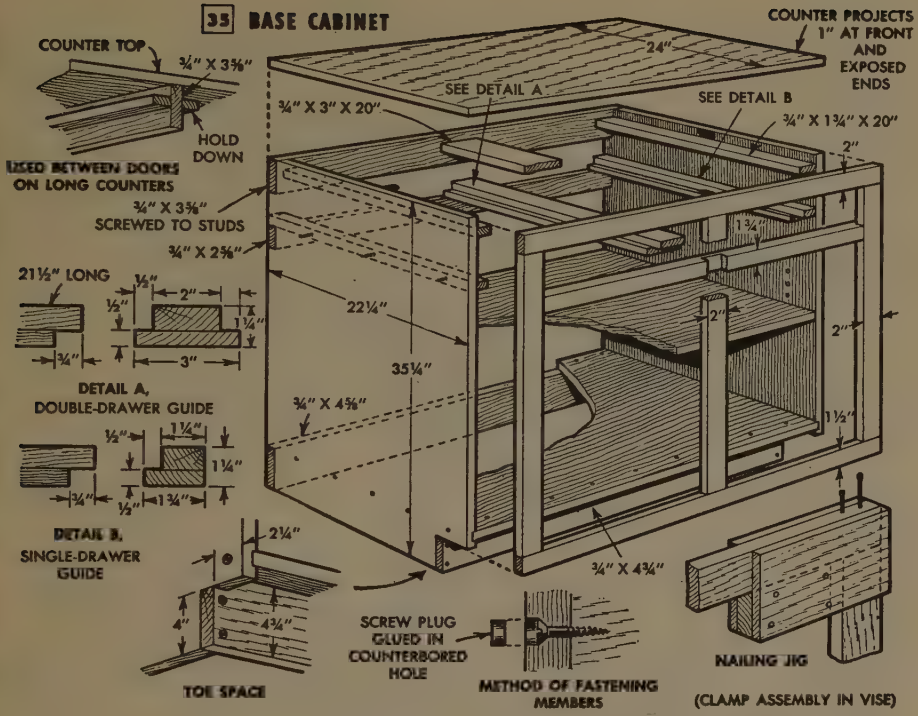
CORNER WALL CABINET



TYPES OF CABINET DOOR HINGES

Kitchen ventilation: An exhaust fan gives a complete change of air in a few minutes to eliminate cooking odors, excess heat and humidity. Air exhausted by the fan is automatically replaced by fresh air drawn in through an open window, or air coming from other rooms. Often an exhaust fan is located over a service door. However, if the range is against an outside wall, a better place for the fan is directly above the range as in Fig. 24. Two other arrangements are shown in Figs. 25 and 26. Prefabricated hoods equipped with exhaust fans are available in various sizes.

Lighting fixtures: It's advisable to have a center ceiling light for general illumination of 10 foot-candles. A control switch should be located at each important entrance. Sink, range and breakfast table can

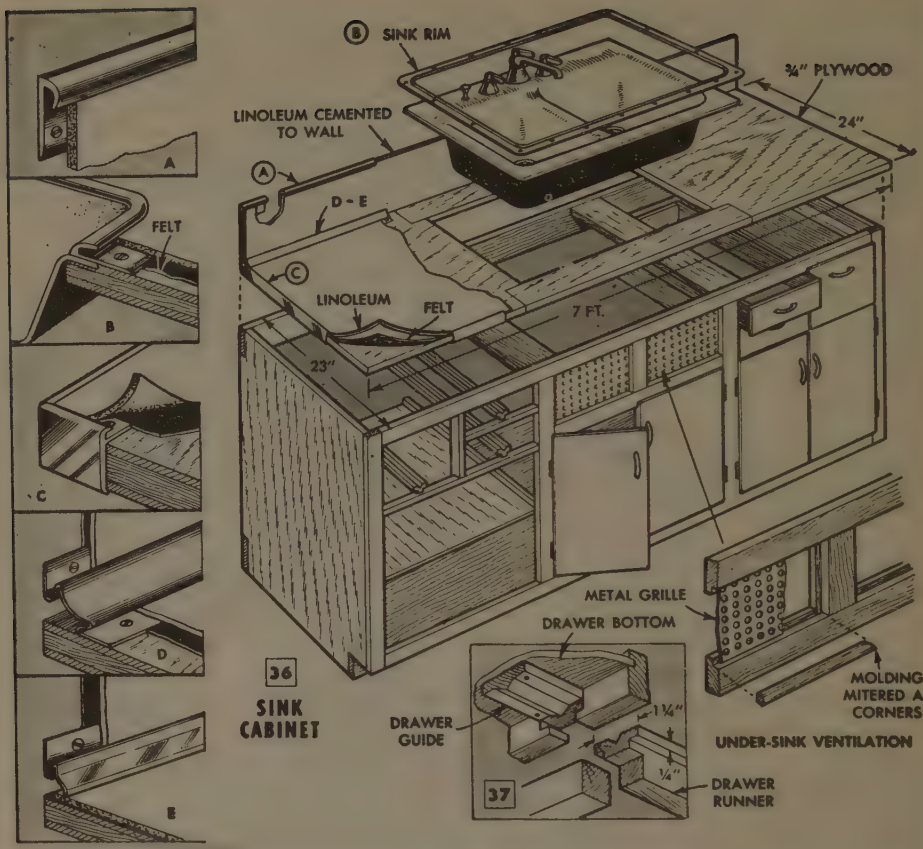


be illuminated from the ceiling with flush-type fixtures which are easy to keep clean. Intensity of light at these spots should be 40 foot-candles. For work areas under wall cabinets, illumination can be provided by tubular lamps, either the fluorescent or filament type installed on the underside of the wall cabinets. It's much better to have too many electrical outlets than too few, and at least two should be provided on each wall. Locate several along the counters, using multiple outlet strips. Others should be provided at the range, refrigerator, exhaust fan, radio, toaster and ironing board.

Installing ready-made wall cabinets: Wall cabinets of 30-in. height are hung so that their tops will come 84 in. above floor level. Most steel cabinets are attached to wooden or metal hanger strips which are fastened horizontally and nailed or screwed into wall studs. The hanger strips, particularly the upper one if two are used, must be absolutely level, Fig. 27. In some cases, hanger strips are used individually on the cabinets; in other cases they extend, as in Fig. 28, to hold more than one cabinet. In still other installations, the cabinets are screwed directly to the walls with the screws driven into studs. On hollow tile walls, toggle bolts are used for fastening, whereas brick walls require screws and expansion sleeves.

When hanging metal wall cabinets, and also when installing base cabinets, the usual procedure is to start from a corner. If your installation does not include corner cabinets having 45-deg. doors, fasten two standard straight cabinets to a metal "corner" filler strip, Fig. 31, C, and to a corner bottom plate. Next, bolt, several cabinets together before screwing them to hanger strips or wall. Steel cabinets are sometimes provided with removable knockouts for bolts used to fasten the cabinets together. If not, holes must be drilled. Wooden cabinets generally are fastened together with screws. Before screwing the cabinets permanently, check with a level to see that the front and sides are plumb. Often it is necessary to use shims behind the cabinets where plastered walls are uneven.

Avoid locating a refrigerator next to a corner wall cabinet as it will interfere with opening the cabinet door. Avoid having a cabinet butt tightly against an end wall, as this would interfere with the operation of doors. This also applies to base cabinets. The needed clearance space between cabinet and wall is concealed by using a "scriber" filler strip, Fig. 31, A. If the wall is

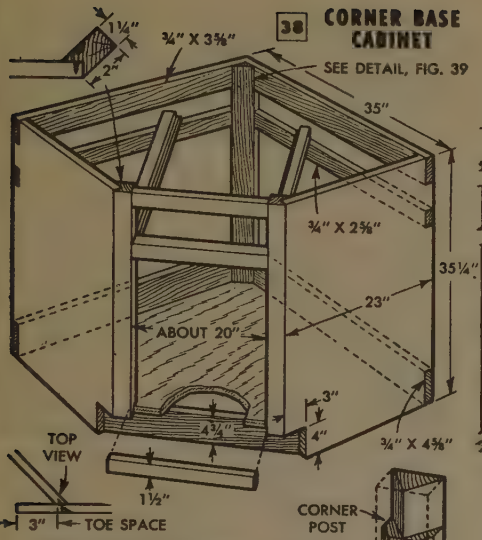


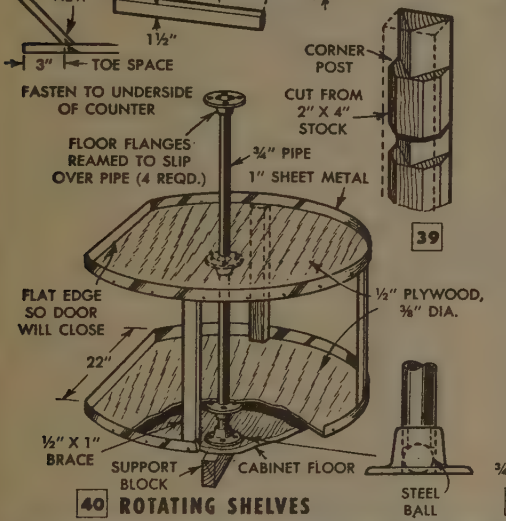
uneven, the strip is held in position, scribed to conform to the wall surface and then cut accordingly with tin shears and fastened in place. On metal wall cabinets having sides that do not conceal the hanger strips, "back" filler strips, Fig. 31, D, are added for concealment. A spacing of 6 to 10 in. is recommended between wall cabinets and windows where rounded shelves, Fig. 30, are used. When it is necessary to fill a gap of a few inches between cabinets to stretch them, an "intermediate" filler strip, Fig. 31, B, is used. These strips come in various widths.

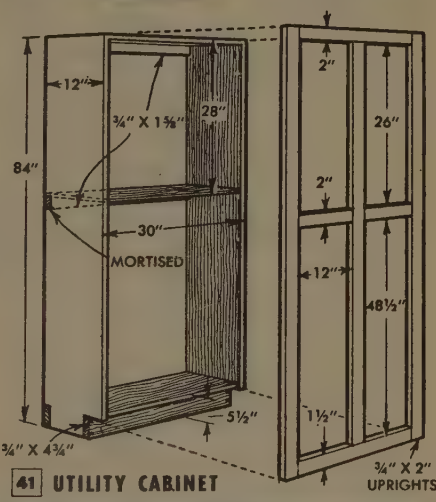
Base cabinets and counters: Installation of base cabinets is started at corners the same as with wall cabinets. If the corner space is not to be used, two straight-type cabinets can be butted together at right angles and a corner filler strip added at the front. Then a counter support cleat is nailed or screwed to the wall studs. Corner space can be utilized with special cabinets having parallel-to-wall or 45-deg. fronts, in which case no corner strips are needed. The cabinets are fastened together, shimmed with wooden wedges to get them perfectly level on uneven floors, then screwed to wall studs. A base shoe will hide the exposed crack where the cabinet is raised above the floor.

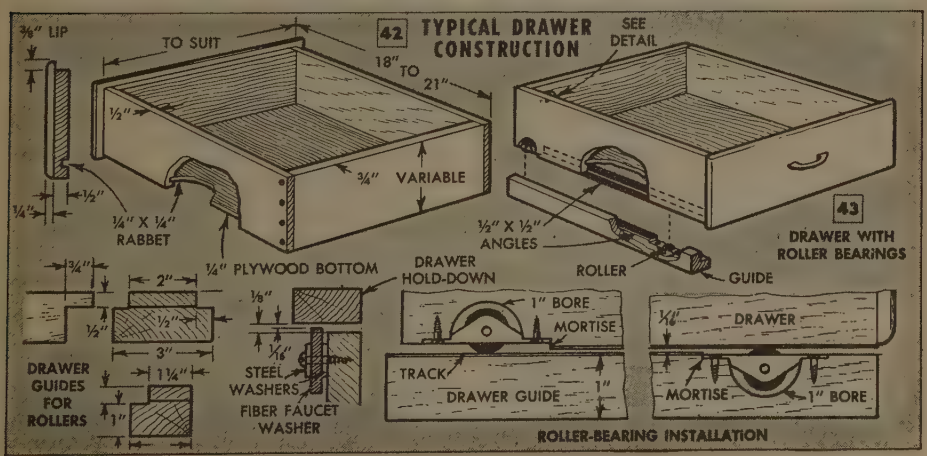
A base-cabinet assembly also can be "stretched" to desired length by either inserting a narrow tray cabinet or else using one or more "intermediate" filler strips between the cabinets. A single counter can extend over the entire assembly although, in some packaged units, individual cabinet counters are provided. Where counters butt against sinks, wedge-shaped filler strips coated with sealing compound assure waterproof joints. Backsplash on sinks and counters may be integral with them, may be attached as separate units, or may be provided by covering wall with linoleum.

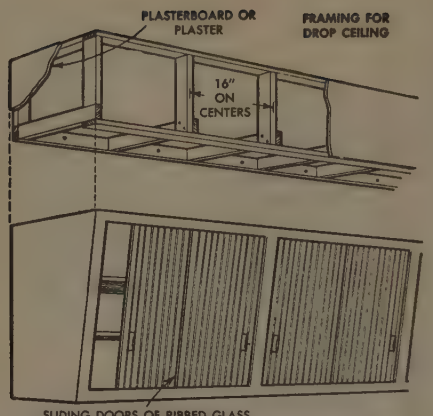
Building your own: Cabinet construction is simplest if ¾-in., 7-ply plywood is used together with solid stock lumber. White pine is good, and so is birch or gum. Thin plywood or hardboard requires additional

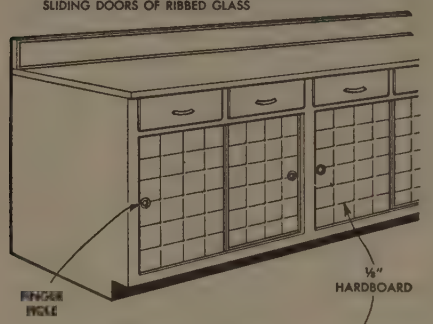

38 CORNER BASE CABINET
1¼"
¾" X 3⅝"
2"
SEE DETAIL, FIG. 39
35"
¾" X 2⅜"
35¼"
23"
ABOUT 20"
3"
4¾"
4"
¾" X 4⅜"
TOP VIEW
1½"
3"
TOE SPACE

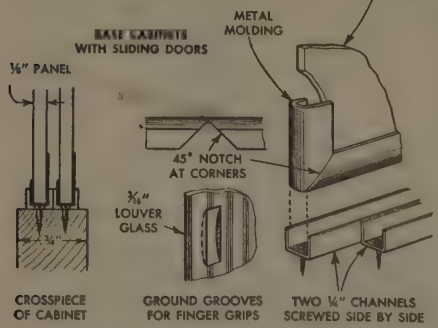

CORNER POST
CUT FROM 2" X 4" STOCK
FASTEN TO UNDERSIDE OF COUNTER
FLOOR FLANGES REAMED TO SLIP OVER PIPE (4 REQD.)
¾" PIPE
1" SHEET METAL
39
FLAT EDGE SO DOOR WILL CLOSE
½" PLYWOOD, ⅜" DIA.
22"
½" X 1" BRACE
SUPPORT BLOCK
CABINET FLOOR
STEEL BALL
40 ROTATING SHELVES

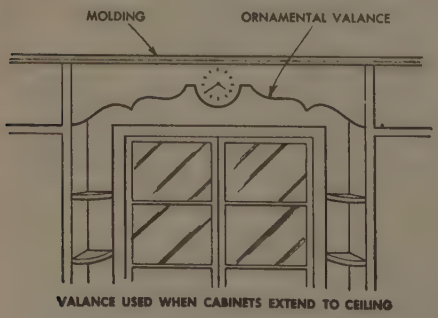

12"
¾" X 1⅜"
28"
84"
30"
MORTISED
2"
26"
2"
12"
48½"
5½"
1½"
¾" X 4¾"
¾" X 2" UPRIGHTS
41 UTILITY CABINET


⅜" LIP
TO SUIT
42 TYPICAL DRAWER CONSTRUCTION
SEE DETAIL
18" TO 21"
½"
¾" VARIABLE
½"
¼"
¼" X ¼" RABBET
½" X ½" ANGLES
43
DRAWER WITH ROLLER BEARINGS
¾"
2"
¼" PLYWOOD BOTTOM
DRAWER HOLD-DOWN
ROLLER
GUIDE
⅛"
1" BORE
MORTISE
⅛"
DRAWER
½"
½"
3"
1¼"
⅛"
STEEL WASHERS
FIBER FAUCET WASHER
DRAWER GUIDES FOR ROLLERS
1"
TRACK
DRAWER GUIDE
1"
MORTISE
1" BORE
ROLLER-BEARING INSTALLATION









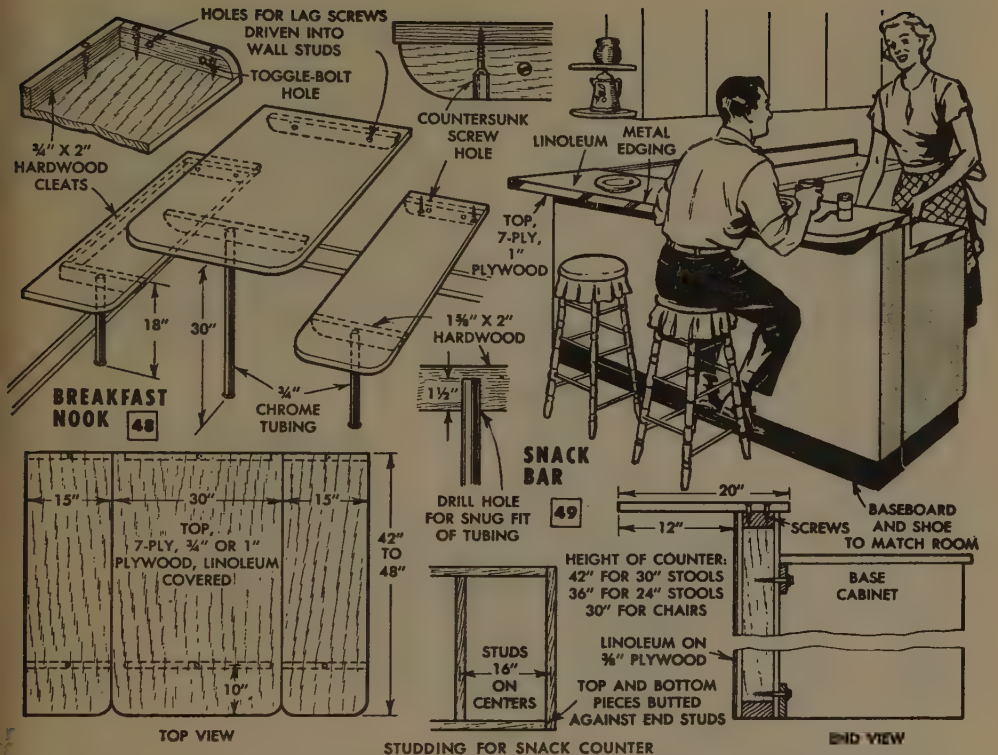
framework and entails considerable joinery. Simple screwed or nailed joints, coated with glue where possible, give adequate strength, although dowels produce stronger joints where narrow stock is butted together. Flat-headed screws are concealed in holes counterbored and drilled for the screw body. A pilot hole should be drilled for the thread portion of the screw, and the screw coated with soap for easy driving. Plugs, cut from dowels that fit the holes tightly, are glue-coated and driven to come flush with the surface. Crack filling, sanding and painting will conceal them entirely.

Making wall cabinets: The top, bottom and sides of wall cabinets, Fig. 32, are 11⅞ in. wide to get four widths, including waste for saw cuts, out of a standard 48-in. plywood panel. Before assembling, the inner faces of the side members are drilled for shelf brackets. Note that the front framework is made separately of solid stock and fastened with glue and 6 or 7d finishing nails. Butt joints of narrow stock can be assembled flush at the sides with the nailing jig shown in Fig. 35, using a C-clamp to hold the joining pieces together tightly. Then two 10d finishing nails are driven in, slightly toed toward each other, and the heads are sunk about ½ in. deep with a nail set. For extra rigidity, hardwood corner blocks are glued and screwed in place. When cabinets extend to the ceiling, the portion above the 84-in. height should have separate doors.

In the corner wall cabinet shown in Fig. 33, the sidepieces of the doorframe are hardwood, rabbeted, glued and screwed to the side panels. Corner posts for wall and base cabinets are made as shown in Fig. 39. Top and bottom of the cabinet extend 1 in. into the doorframe so that ¾-in. inserts will fit flush with the front.

Rounded shelves to flank windows are detailed in Fig. 30. Three types of modern cabinet doors are shown in Fig. 29 and five types of hinges are shown in Fig. 34. In fitting the doors, allow 1/16 in. all around the opening for clearance.

Construction of base cabinets: Baseboards are removed for installing base cabinets detailed in Figs. 35 and 38. Toe space should be 4 in. high and 3 in. deep. If desired, the cabinet floor may be set into ⅛-in. grooves in the sides for added rigidity, the floor being glued and screwed through the sides. As with wall cabinets, the front framework is made separately and, after it is attached, the drawer guides, hold-downs and counter-support crosspieces are installed. An alternate arrangement for drawer guides, using a single V-shaped guide for each drawer, is shown in Fig. 37. For ventilation under a sink, metal grilles are advised, and counters can be screwed



to the base units by using angle brackets.

As corner base cabinets, Fig. 38, are too large to pass through doors, they must be assembled in the kitchen. Note that the doorframe is similar in construction to that of the corner wall cabinet. Rotating-shelf units, called Lazy Susans, Fig. 40, are labor-savers. Floor flanges, reamed out to slip over ¾-in. pipe, serve as bearings. A steel ball carries the weight. Three or four braces between the shelves and a block under the cabinet floor are required.

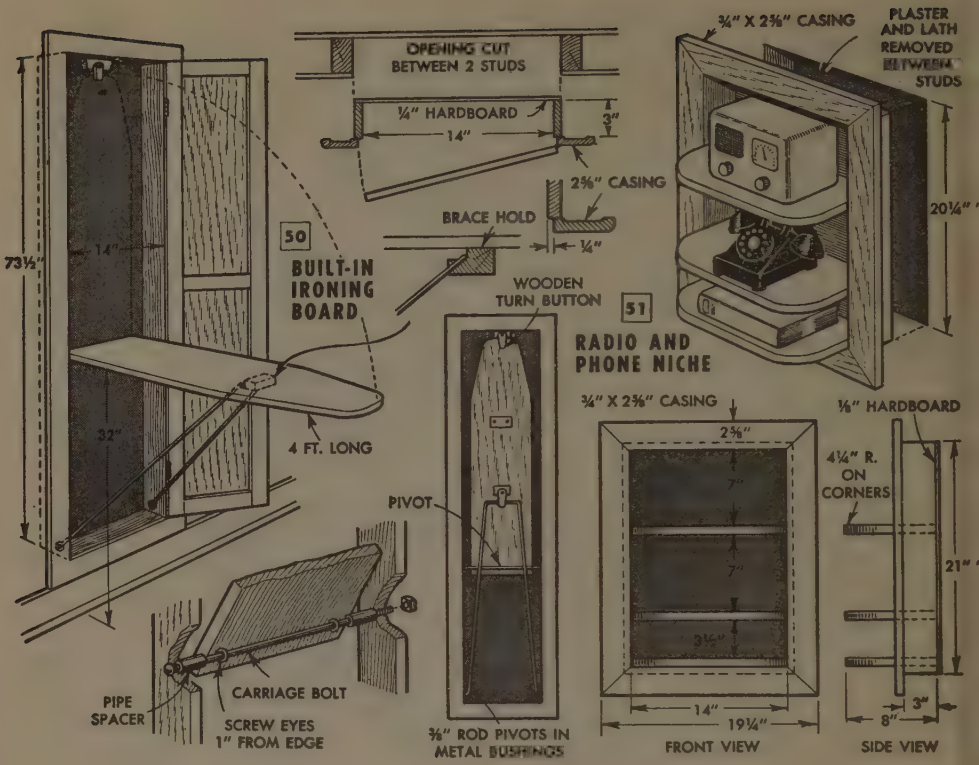
Drawer construction is shown in Fig. 42. A clearance of 1/16 in. at the top and at each side of a drawer prevents binding. Utility cabinets usually extend to the top of wall cabinets. Fig. 41 shows construction.

Roller bearings for drawers: For easy-action drawers, you can use rollers and tracks as shown in Fig. 43. One roller is recessed in each side of a drawer at the back, and another is recessed in the front end of each guide. The guides must be hardwood. Tracks are ½-in. metal angles. The rollers project slightly beyond the track surfaces for clearance. Fiber washers at the drawer tops are arranged to rotate on screws to minimize friction against the hold-downs.

Covering counters and table tops: Materials used for this purpose include linoleum, plastics and ceramic tile. In some states building codes specify what to use. Linoleum is laid over felt, Fig. 36, both the felt and linoleum being cemented with waterproof cement.

To apply sheet plastic, you spread special adhesive on the clean, dry counter or table top, and also on the underside of the plastic sheet. Let the adhesive air-dry from 40 mins. to 2 hrs. The temperature should be 70 deg. F. Test the cement for dryness by pressing a piece of heavy wrapping paper on the surface. It should pull free without picking up any of the cement. Then place a piece of wrapping paper over the cement, and lay the plastic sheet, already cut to exact size, over this. (The plastic can be cut with a fine-tooth saw held at a low angle to prevent chipping along the edges.) Then pull out the paper and press the plastic down into firm contact with the counter. For this you can use a rolling pin.

A variety of moldings in anodized aluminum, stainless steel and plastic can be obtained for installation at edges and corners of counter-covering materials. Types of moldings are shown in Fig. 36, details A to E.



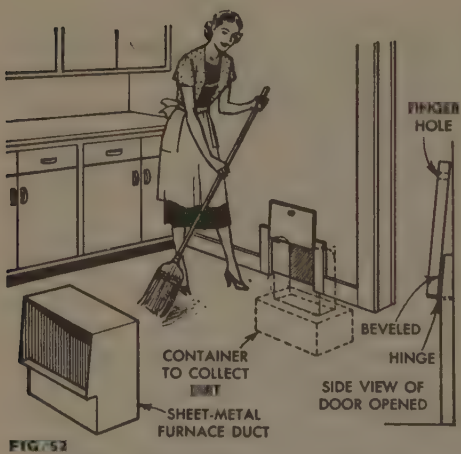


FIG. 52

Sliding cabinet doors: To make sliding doors of ⅛-in. tempered hardboard, you cement panels of this material in stainless-steel channels as shown in Fig. 46. By making 45-deg. cutouts, the stock can be brought around corners neatly. Metal channels of large size serve as slides. Bezels frame the finger-grip holes. Sliding doors of glass are attractive for wall cabinets, Fig. 45. A channel is secured to the top and bottom edges of the glass, using special mastic. Sharpness along the edges of glass can be removed with emery cloth held on a block or flexible pad. Shallow grooves are ground in the glass for finger grips.

Valances and drop ceilings: When cabinets extend to a ceiling on either side of a window, a valance as in Fig. 47, greatly improves the appearance. A drop ceiling or soffit, to close the waste space over wall cabinets, should be installed before the cabinets are put in place. The framework, Fig. 44, is nailed to ceiling joists and wall studs.

Breakfast nook and snack bar: Construction of a simple breakfast nook is shown in Fig. 48. Cleats on the underside of seats and table top are flush with their edges, and are attached to walls with lagscrews into studs, or toggle bolts where studs cannot be located. Other cleats across the underside of the table and benches are bored to take chrome-plated, steel-pipe legs, which may be fitted with rubber crutch tips.

One end of a snack bar can be attached to a wall, or one side may be backed against a base cabinet or range as shown in Fig. 49.

FIG. 53

FIG. 54

Photos courtesy Gerity-Michigan Corp.

FIG. 55

FIG. 56 Photos courtesy General Electric Co.

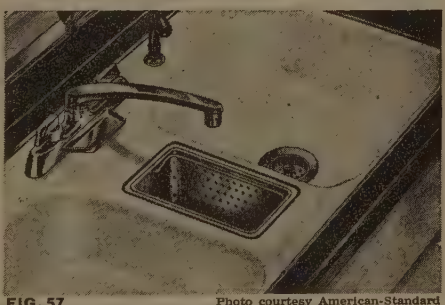


FIG. 57 Photo courtesy American-Standard

The framework is covered with plywood or hardboard, and the ¾-in. plywood counter with a sheet-plastic or linoleum covering.

Built-in conveniences: You can purchase a readymade cabinet-type ironing board, or you can build one yourself as shown in Fig. 50. A wall niche, Fig. 51, to hold a radio or telephone, can be installed similarly. A dust chute, Fig. 52, allows floor sweepings to drop into a container hung underneath.

Kitchen worksavers: Figs. 53 and 54 show a mixing faucet combined with a hose and brush through which either water or dissolved detergent is dispensed for convenience in dishwashing.

A fully automatic, electric dishwasher, Fig. 55, requires only loading of dishes scraped clean of food morsels, filling the detergent cup, closing the unit and turning on the control knob to start the motor. All other functions then are automatically performed in cycles.

An electrically driven garbage-disposal unit, Fig. 56, pulverizes garbage so that it can be safely carried away through drainage lines. It can be connected to almost any sink having a 3½ or 4-in. drain opening. The trap and waste line into which the unit discharges should not be less than 1½ in. in size. Ordinary wastes such as food leftovers, bones, vegetable parings, fruit skins and pits, and a reasonable amount of paper can be passed through such units. They are not designed to dispose of rubbish, tinfoil, shells, string, or pieces of metal, glass and pottery. In use, waste is dropped into the unit, a moderate stream of cold, not hot, water is turned on, and then the unit is switched on.

Fig. 57 shows a double-compartment sink having a removable built-in garbage well which is connected to the sink drain pipe. The spout can be swung directly over the basket to rinse the contents before final disposal.